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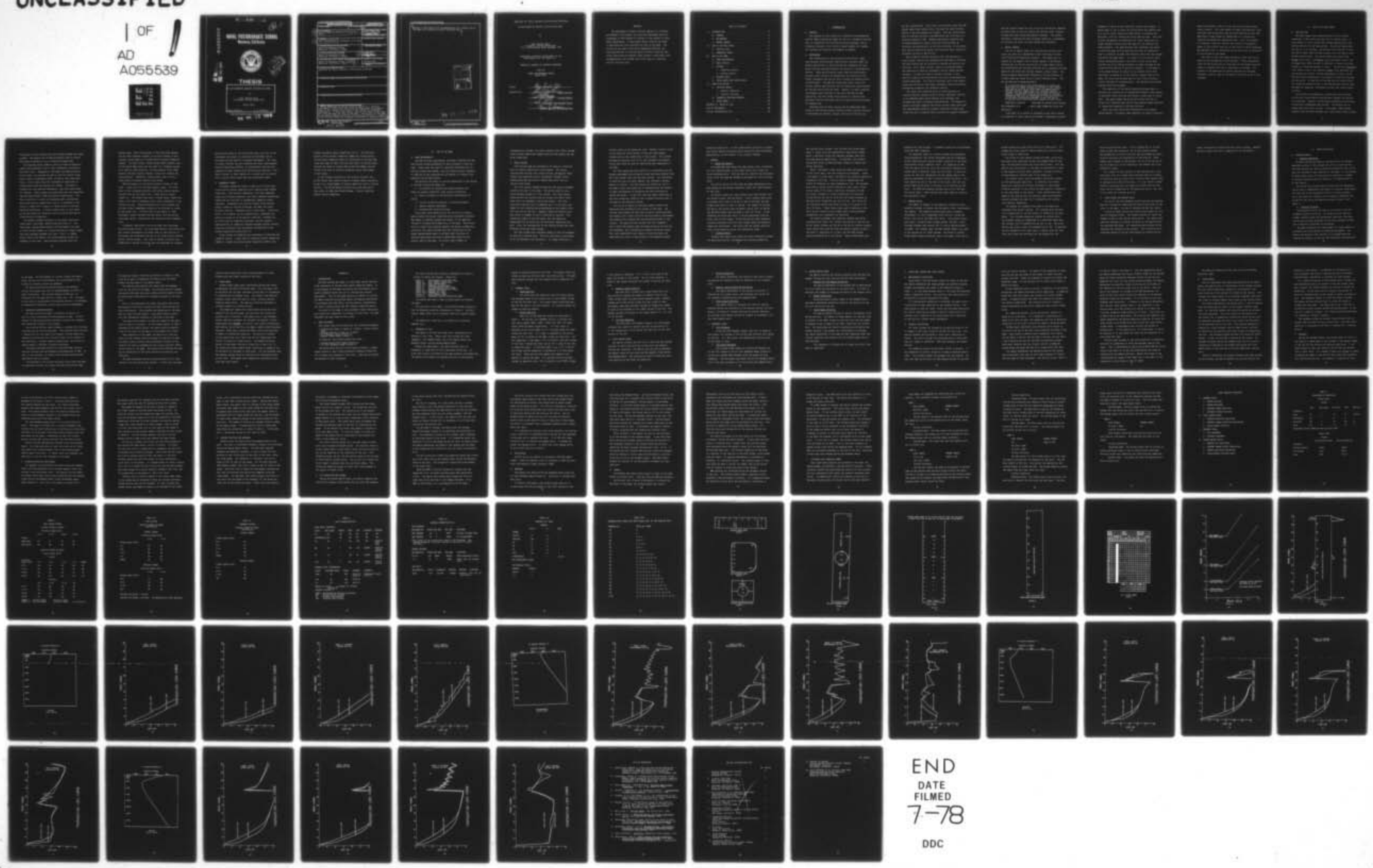

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Monterey, California

THESIS

AN ANTISUBMARINE WARFARE TRAINING WAR GAME

by

Gary Leonard Coyle
Lieutenant, United States Navy

March 1978

Thesis Advisor: A. R. Washburn

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An Antisubmarine Warfare Training War Game

by

Gary Leonard Coyle
Lieutenant, United States Navy
B.S., United States Naval Academy, 1972

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

from the

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The employment of manual tactical gaming in a training environment is discussed, outlining the advantages and disadvantages of this method of training in the context of shipboard requirements. A two-sided, manual tactical war game is described and rules provided for play of the game. The utility of the game in assisting Commanding Officers and Training Officers in training junior officers using the Personnel Qualification Standard (PQS) System is described, with recommendations for further use of the game as a possible tactical training tool.

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I. INTRODUCTION

A. PURPOSE

The purpose of this study was to develop an antisubmarine warfare (ASW) training war game for use as a shipboard training tool in conjunction with existing training packages, and to stimulate interest in the field of manual gaming as a method for training and tactical development in general.

B. BACKGROUND

The introduction of the Surface Warfare Officer (SWO) qualification and Personnel Qualification Standard (PQS) for Warfare Specialties in 1975 provided the framework for shipboard training and qualification of officers in antisubmarine warfare. These qualifications arose from the evolutionary process within the Navy to standardize the training of personnel throughout the service and to establish minimum levels of proficiency. The SWO PQS established these levels for initial officer qualification and for additional qualification as Tactical Action Officer (TAO). However, no watch standing requirements were included in the basic SWO PQS for ASW speciality, nor were formal lesson plans or training aids provided, forcing individual units to create training packages for onboard use.

Although both the Basic Course and the Department Head Course of the Surface Warfare Officer Schools provide training in antisubmarine warfare, onboard training of officers was

was not standardized. Since final qualification under the PQS System takes place onboard ship, the need for some training device in the environment was evident. This was particularly true of officers serving on non-ASW ships and in billets not directly related to ASW. Reduced operational schedules and increased demands on inport time have placed burdens on training, and particularly on off-ship training, to the extent that the utilization of ashore facilities has been limited to personnel serving in ASW billets.

While onboard training devices exist, the majority of these systems require that equipment be dedicated to training and that technicians be available to operate and monitor the training. Also, these trainers tend to be oriented toward the operation of specific equipments and not toward general concepts. If they are used in general training, a very specific scenario and coordination plan must be developed and closely monitored. This type of training, while very useful, cannot be carried out with great frequency without disrupting maintenance schedules and shipboard routine.

The author was concerned with providing guidance to training officers onboard ships to allow individual training to be conducted which would improve unit readiness and increase the level of personal qualification. The absence of readily available computer facilities on most fleet units and the requirements placed on systems installed on others precluded the use of computer-based training for general purposes,

and the lecture format was felt to be too limited for complete training since it did not require the officer under training to make decisions concerning general concepts. The author, therefore, examined the area of manual gaming as a supplement to lectures and other training systems now available.

C. MANUAL GAMING

The use of manual games for training and tactical evaluation has been well documented in the literature of both naval history and operations analysis. The author was impressed by the general use of manual gaming in operational planning and in officer training by all major powers during the Second World War and the continued use of computer-assisted gaming by the Naval War College, Newport, Rhode Island. The decision-making opportunity afforded to the participants in a manual game was found to be of great training value. This was pointed out by Hendrickson[1]:

> As a training device the concentration of events and decisions in a game creates an interest in the subject that may be lacking in other means of communications. Besides aiding a common basis for exchange between players, the war game sparks the critical analysis of specific assumptions on which the problem is founded. Weaknesses may turn to advantages by focusing attention on the more confounding problems in the real world situation and on what approaches appear to have value.

Additional learning experience may be gained from studying the responses of players to their game responsibilities and decisions.

A war game is an effort to represent a real world system or situation in such a way as to provide a reasonably accurate

framework in which to test decision, tactics and weapons. A manual game is one in which the participants and umpires rely on a set of rules, tables and odds charts to evaluate the decisions, with all records and plots kept by hand. The rules of play and methods of evaluation for manual games must be simple enough to ensure that the game will be playable and understandable. The game designer must determine the manner in which the game will be used and the level of complexity that is essential to model the necessary decisions and systems with which the game deals. If a game is to be used by relatively experienced players, the rules of play can be made flexible and allow the participants to adapt the game to the situation which may be of the most interest. If the game is to be played without an umpire, or by players with little experience in gaming or in the specific subject area of the game, the rules must be made more or less rigid, allowing little latitude for interpretation. The designer must decide between these two extremes.

The simplicity of the manual gaming technique makes it possible for training to be accomplished without large numbers of personnel being involved and without a great deal of equipment. The manual games can be played quickly and can be fitted into schedules more easily than computer-based training or large-scale onboard or off-ship trainers.

There are some significant limitations to the manual gaming method. The manual game endeavors to create a decision

making environment similar to the real world without being overly complex. The large number of human interventions, both decisions and evaluations, and the time required to play each game make a large number of repetitions of a scenario an unattractive method for generating data. Also, the element of "strategic learning" affects the results of successive games as the players learn to use the rules to their advantage. Any designer bias or inaccuracy in the rules will be reflected in the outcome of the games.

The rules of play are simplifications of the real world, based on the assumptions of the designer. These assumptions limit the decisions that are available to the players and the number of systems that can be simulated in the game. The purpose of the game must be clearly defined and the game, therefore, must be used in the specific area for which it was intended.

II. ASW IN THE REAL WORLD

A. TACTICAL ASW

All major powers have emphasized the role of surface combatants in ASW during the past ten to fifteen years. A large number of ship classes with primary ASW missions have entered service in that same period. The United States Navy has built, or is building, the DD 963 class, the FFG 7 class, and the FF 1040, 1052 and 1078 classes, all with ASW as their primary mission area. The Soviet Union has launched the Krivak class escort, the Moskva class helicopter carrier and the Kiev class VSTOL carrier in addition to several existing classes of "large antisubmarine ships." The British Invincible class VSTOL cruiser, the Canadian Tribal class destroyer and the purchase by several foreign governments of FFG 7 and DD 963 class ships demonstrate the concern for ASW felt throughout the world. In addition to the ASW role of surface units, an increasing responsibility in the ASW mission area has been assigned to submarine, land-based aircraft and carrier based aircraft.

The variety of contemporary surface ASW units provides a difficult classification problem where weapons and sensors are concerned. However, several broad categories can be used to describe contemporary ASW systems. The weapons can be broken down into three classes: long-range, rocket-thrown weapons, deck-launched torpedos and rocket-thrown depth charges.

The sensors can be divided into hull-mounted systems and towed systems. The general use of ASW helicopters both as search and attack platforms is also a feature of modern ASW.

Hull-mounted sonars combine active and passive detection capabilities mounted in one or more transducers attached to the ship's hull. Depending on the power and sophistication of the sonar, the ship may be able to utilize several sound paths, such as convergence zones, to obtain long range detetions. Active sonars have the advantage of being able to provide both range and bearing to a target. The passive systems give only bearing information, requiring other means for ranging. Towed systems are subdivided into two categories: Variable Depth Sonars (VDS) and passive towed arrays. The VDS is similar to a small hull-mounted sonar, having both active and passive capabilities, but it is tethered to the ship by a cable and is towed at a depth giving it the best operating conditions. A passive towed array is also towed at the best depth for detection and can provide bearing and classification information.

The weapons systems currently in use cover three basic range zones, long range, medium range and close in. The long-range, rocket-thrown weapons and helicopters are used to carry an ASW torpedo to a target detected at longer ranges than deck-launched torpedos can reach. The U. S. ASROC, Soviet SS-N-14 and SUW-N-1 and French Malafon systems are examples of this type. Deck-launched torpedos cover the

medium range. Both the payloads of the long-range weapons and the deck-launched torpedos are acoustic homing in most systems, giving them an increased ability against submarine targets. The short-range, rocket-thrown depth charged, such as the Soviet RBU series and the older U.S. hedgehog system still used by some countries, are used against close range contacts and most usually achieve a direct hit without any homing devices. Therefore, these systems tend to fire a large number of weapons against each target.

ASW helicopters are carried by several classes of ASW ships. These units are of three general types. The first type is only a weapons platform, delivering attacks against contacts held by the parent ship. These have no sensor capability. The second type have a limited sensor capability, often in the form of sonobouys which relay information to the controlling ship. These helicopters also carry weapons and can make either independent attacks or be directed to attack by the parent unit. A third class of helicopter is semi-autonomous, being launched from the parent ship but making long-range search, localization and attack missions independently.

In general, ASW tactics can be divided into long-range and short-range tactics. In long-range tactics, the controlling ship directs helicopters and other ships to the locality of the target and coordinates the use of all assets while avoiding attack from the target. This type of attack is usually developed over a period of time and has the advantage of allowing

the decision maker on the controlling ship to be out of the area where the attack is occurring and therefore not be involved with the details of weapons employment. The close in attack involves the use of medium and short range weapons from the attacking platform, in coordination with the helicopters and other surface units which may be involved. This type of attack is more complex for a single unit to control and is usually more urgent than the long-range attack.

B. SUBMARINE THREAT

The modern submarine threat is made up of a long-range cruise missile attack capability and a medium range torpedo capability. Both nuclear submarines, with high submerged speed and unlimited endurance, and diesel powered conventional submarines are involved in contemporary submarine attack scenarios. Submarines can localize targets using passive sonars, radars or outside platforms, and they can launch missiles from the submerged state in many cases. The Soviet SS-N-7, for example, can be launched from a submerged submarine at ranges up to 35 nautical miles.[3] Torpedos can be fired from all submarine platforms, and the acoustic homing ability of submarine launched torpedos against surface ships has increased since the German introduction of the homing torpedo during World War II.

Three classes of submarine are considered in assessing the submarine threat: cruise missile launching nuclear submarines (SSGN's), torpedo launching nuclear submarines (SSN's) and

torpedo launching diesel submarines (SS's). The ballistic missile firing nuclear submarine (SSBN) and cruise missile firing diesel submarine (SSG) are discounted in tactical ASW since the range of their missiles puts their firing positions outside the range of surface ASW systems and SSBN's are not likely to be used in tactical submarine versus ship combat in most cases.

In the classes concerned in the tactical picture, the Soviet forces have several classes of modern SSGN's and SSN's, as well as a large number of diesel submarines still in active service. The United States currently has both SSN and SS type units, as does the United Kingdom. Several countries operate diesel submarines.

III. ASW IN THE GAME

A. GAME REQUIREMENTS

The ASW training requirements outlined in SWO PQS and TAO PQS provide minimum standards for qualification in both systems. These cover the specific operating characteristcs of various systems and weapons, and also broad tactical concepts, in addition to the organization and methods of internal ship operation during ASW actions.

The decision and areas of training emphasized in the design of the ASW Training War Game are:

1. The effects of platform and target maneuver and speed on acoustic detection, both active and passive.

2. General concepts of multiplatform coordination in search.

3. The use of ASW helicopters in search and attack.

4. General weapons employment.

5. Screening and evasive actions.

These areas were chosen due to the ability of a manual game to model the actual conditions with acceptable accuracy. The number of weapons systems and sensors in the game was limited to increase the playability of the game. While exact data on current and projected weapons and sensor systems was available, the author decided that the limitations of the manual gaming method made it unlikely that inclusion of accurate data would have had a significant effect on the tactics used in the game. By using a small number of

representative systems, the major concepts that affect systems could be more effectively demonstrated to the players and the rules simplified.

B. BASIC DESIGN

The training game was designed to be used as a training tool for general ASW tactics and concepts. The forces involved were divided into surface forces, designated "Blue" forces, and submarine forces, designated "Orange" forces, representing the abilities of modern ASW units, but not specific ship types.

The first design assumption made was the type of movement system to be used in the game. The choices were to use a rigid movement system or a free system. The rigid system required that the playing area be divided into small resolution cells for movement, search and attack. The units could move from one cell to adjacent cells in the grid, the number of cells entered being determined by the speed of the unit and size of the cell. Weapons ranges and effects were also given in numbers of cells travelled or covered. This system was simple to use and teach, but the speed and maneuverability of units was not accurately modeled by the grid. Also, the reproduction of the playing surface was more difficult using the rigid system.

The free system used a maneuver gauge to plot the movement of units on a playing area. The unit could move at any speed up to its maximum in any direction. To change direction, a

turning radius on the gauge was used. Weapons could be fired in any direction using weapons firing and range gauges, limited only by the constraints of the system. This system provided an accurate plot of all unit movement and weapons firing that could be used for debriefing upon completion of the game.

The free system was more difficult to understand and the weapons employment and evaluation rules were more complex than the rigid system rules for the same actions. The evaluation of detection was also more complex, but afforded a greater degree of realism. The free system was chosen for use in the game to meet the objectives of demonstrating the effects of speed and maneuver on detection and the principles of search and attack. It was felt that the added complexity of the free system was offset by the increased accuracy that it afforded to the detection system.

The use of an umpire to evaluate weapons effects and detections was dictated by the purpose of the game. The limited intelligence derived from an umpire system provided the players with a more realistic decision-making environment. This method also lessened the record keeping burden on the players. The game turn was divided into four segments, one in which the players make the game decisions and one for unit movement, each followed by an umpire evaluation phase. This turn organization was chosen to give the players an opportunity to react to the actions of the opposing player

during the game turns. A turn organization using only a player turn and an umpire evaluation phase caused the decision-making opportunities of the players to be severely limited.

C. SENSORS

1. Submarine Sensors

All submarines were given the same sensor suite, consisting of a hull-mounted sonar, a periscope system and a radar for use by surfaced units. This was done to simplify the evaluation rules, since the game was primarily designed for use by surface units.

The active portion of the sonar was made deterministic for both detection and counter detection, again for simplification of the rules.

For passive detection, the surface units were divided into two target classes, HVU and Escort. Escort targets were given a radiated noise level of 97 dB re 1uPa at 10 knots and HVU targets were given a level of 109 dB. For speeds of 25 knots and above, the Escorts were assigned a noise level of 108 dB and the HVU targets were assigned a level of 114 dB. If the submarine was below the layer, 6 dB was subtracted from the noise level of the target. Using the passive sonar equation, a passive detection curve for both target types and submarine depths was constructed. The curve used the target speed and class as the entering values for determining range.

2. Surface Sensors

Surface units were given radar and visual detection systems for detecting missiles, periscopes and surfaced submarines.

The surface sonar systems were divided into three types: Sonar 1, Sonar 2 and the Hypothetical Towed Array (HTAS). Sonar 1 and Sonar 2 were hull-mounted systems, both with the same passive capabilities. In addition, the surface forces were given an ASW helicopter capable of search and attack functions.

Sonar 1 and Sonar 2 were given the same characteristics in the active mode, with the exception of frequency. Sonar 1 was made a 3.0 kHz sonar, and Sonar 2 was given an operating frequency of 6.0 kHz. This was done to demonstrate the effect of frequency on sonar propagation loss. The systems were given a source level of 220 dB re 1uPa, with a directivity index of 10 dB and a detection threshold of 0 dB. The target strength of nuclear submarines with missiles firing ability was set at 10 dB and the target strength of SSN and diesel submarines was set at 5 dB. Self noise for the platforms varied from 54 dB re 1uPa at 10 knots to 74 dB at 25 knots. These figures were used to generate a hull sonar active figure of merit (FOM) table, giving maximum propagation loss acceptable for detection.

For passive systems, the submarine targets were given radiated noise levels that varied from 122 dB re 1uPa to 143 dB for diesel targets and 129 dB to 140 dB for nuclear targets. These levels were used for both the passive system of Sonar 1 and Sonar 2, operating at 1.9 kHz, and the HTAS system, operating between 50 Hz and 150 Hz. Passive FOM tables were

prepared for both systems. A sonobouy system was also designed, using the HTAS frequency.

The detection range for surface systems was determined using propagation loss curves developed from the Integrated Carrier ASW Prediction System (ICAPS) installed in the Naval Postgraduate School computer center. By comparing an FOM from the tables with the curve for the proper frequency and target depth a detection range could be found. A series of curves for the four frequencies and two depths used in the game was generated for four locations around the world. The layer depth was set at 100 feet in all cases, with the submarine depth being given in relation to its position to the layer. The HTAS and sonobouy systems were set at 150 feet for source depth. These choices were again made to simplify the evaluation rules.

D. WEAPONS RULES

The number of weapons in the game was limited to representative systems to prevent the evaluation rules from becoming too complex. The submarine forces were given a torpedo, designated T-1, and a submerged launch missile, called the SS-N-1, for use by the SSGN class ships. The surface forces were given a rocket-thrown torpedo system, the RTT, a deck-launched torpedo tube system, the TT, and an ASW Helicopter, the ASWH. One torpedo type, the ASW Torpedo (ASWT), was used as the payload on all three systems. No close-in, rocket-thrown depth charge system was used in the game, since the TT

system covered the range band from zero to 7500 yards. The torpedo was given acoustic homing capability, with an acquisition range of 1200 yards.

The firing of each weapons system was made, using range and acquisition templates, during the Command Phase of each turn, and evaluated during the Scond Umpire Phase. This was done to give the players in the game an opportunity to react to the weapons fired by their opponents, instead of having to anticipate all actions open to the enemy unit.

For surface units, only one weapons system was allowed to fire during each game turn. In addition, the surface player was required to indicate the depth of each weapon fired, to determine if the attack was made against a submarine at the same depth as the weapon. These restrictions were added to the game during play testing, when multiplatform attacks provided too high a kill probability for surface units against submarines.

The weapons hit probabilities used in the game were developed from several sources. All torpedos were assigned a hit probability of .50 for attacks on targets at the same depth. This included submarine attacks on surface units. For torpedo attacks on submarines at a different depth than the torpedo, the hit probability was set at .20. The SS-N-1 missile was given a basic hit probability of .80. To generate the hit probability for each class, a typical ship for that class was chosen and evaluated for the probability the

missile would be shot down. A kill probability of .10 was given to each gun system and .20 to each missile system. The probability of missile survival was calculated and multiplied by the basic hit probability of the missile. These numbers were rounded to the nearest .05, to allow the use of two six-sided dice in hit resolution, and formed into a hit probability table.

As a result of play testing, it was decided that a ship could only fire on a target which that ship held on a sensor, or which was held by a ship with a tactical data system (TDS) in contact with a TDS firing ship. If a unit fired a weapon during a turn which was not aimed at a target held by that ship, the hit probability of the weapon was set at .00, even if all other hit criteria were met.

E. INTELLIGENCE AND UMPIRE RULES

The use of the free movement system required the development of a system for comparing the relative positions of the units in the game. The use of acetate overlays was chosen.

A piece of matte acetate was used by each player to overlay the playing surface. The players plotted all moves and weapons tracks on the overlay using pencil. The umpire then used the overlays to transfer the moves to the umpire board and evaluate the moves. All detections were plotted on the overlays and returned to the players. This proved to be an excellent method of giving intelligence and simulating the

actual information received from the various systems. Weapons and ship tracks were easily compared for hit evaluation.

IV. GAME APPLICATION

A. TRAINING MODELS

1. Acoustic Detection

The ASW Training War Game was designed with the acoustic detection portion of the package for use as a training tool. The ICAPS program was used to generate propagation loss curves that are included in the scenarios of the game. In the process of using these curves for evaluation of detection, a number of factors affecting acoustic detection are demonstrated to to the players.

The curves and related sound velocity profiles generated can be used to demonstrate the effect of location, water depth and velocity on the propagation loss for various systems. Also, the effect of frequency can be shown by comparing the curves for the active and passive systems of Sonar 1 and Sonar 2.

2. Tactical Training

The principle aim of the game is to provide a tool for shipboard tactical training. In connection with the PQS system, exercise plans and operational exercises, the game can be used to train personnel in the basic concepts of ASW and in specific evolutions for exercises.

The game eliminates the requirement for large numbers of personnel and large amounts of dedicated equipment. The umpire can decide on the training to be accomplished and require the players to plan for the evolutions required prior

to the game. The development of screens, attack and search plans, and the use of helicopters can be evaluated in the context of existing tactics and methods.

The game could be used onboard ship by the training officer to evaluate the level of accomplishment of officers under instruction. The various aspects of ASW could be discussed with the game used as a visual aid. The game could also be used in conjunction with exercise pre-sailing briefings, to demonstrate formations, search plans and unit employment.

B. SUGGESTED TRAINING METHODS

The ASW Training War Game is primarily of value as a part of a well structured training program in ASW. The PQS system for SWO qualification provides an outline for subjects that should be covered in the program.

The training officer should prepare a syllabus for training, including use of the training game. This program should include a lesson plan for each game to be played, listing objectives, methods to be used and the principle points to be covered in the debriefing. Without adequate preparation, the utility of manual games in training is greatly decreased.

The umpire assigned should be a qualified SWO, familiar with the tactical and environmental considerations of ASW. If this is not possible, an officer with previous game and ASW experience can be assigned.

The wardroom or CIC on most destroyer class ships provides an excellent location for playing the ASW Training War Game.

The opposing players should be positioned on tables in such a way as to make it impossible for them to see the other players playing sheet or the umpire sheet.

The overlays and playing area sheets must be prepared prior to the start of the game. The overlays must be aligned accurately with both the player surface and the umpire surface, to ensure that intelligence is plotted correctly on the overlays.

Prior to the beginning of a game, the umpire must brief the players on the units involved on their side and any pre-game intelligence. The situation and objectives of the game must be clear to both players. Each player should receive only the information essential to the play of the game.

The umpire must endeavor to keep the length of the game turns as short as possible. As the largest amount of time is consumed by the umpire phases, the umpire must be prepared prior to the start of the game, or long delays will result.

Upon completion of the game, the umpire will take the plots and the records from the players and debrief the game. The umpire should discuss the environmental factors of the scenario in terms of propagation loss curves and their affect on the course of the game. Any points which affected the game due to limitations of the rules should be pointed out and discussed.

The game equipment should be made available to all duty sections, for use during duty periods. In this way, the game

could be used effectively with a minimum amount of interference with the normal routine of the ship.

C. OTHER GAMES

Several other games were investigated during the course of designing the ASW Training War Game. One such game, used by the Naval War College, provided a great deal of information on organization of weapons rules. The scope of the game was slightly larger than the tactical level, covering several thousand square miles. The game was primarily designed to evaluate surface to surface actions.

Two commercial games were investigated during the development of the training game, and both were play tested for possible use in training. Both games used a rigid movement system, employing hexagons for movement and weapons firings. These games were UPSCOPE, a tactical level game by Simulations Publications INC of New York, and SSN, a game by Game Designers' Workshop. Both games covered the modern period and provided a number of interesting scenarios. The detection systems of both games were very simple and did not demonstrate the effects of speed to a great extent. The weapons delivery system in both games involved a simple hit or miss roll if the target was within weapon range, resulting in speeds of up to 250 knots for torpedos in some cases. All the problems with the weapons systems could be resolved with some modification of the rules. Both games were commercially available at the time they were played.

APPENDIX A

1. INTRODUCTION

The ASW Training War Game is a two-sided, manual tactical level simulation of surface ship versus submarine combat. It is the purpose of the game to provide the participants with a simple shipboard device for use in training and tactical development. Play of the game requires an umpire, to control the game situation and provide sensor and weapons evaluations in accordance with the rules, and two players, representing the "Blue" surface forces and the "Orange" submarine forces.

The scale of the game is one centimeter equals 1000 yards and a game turn represents six minutes of real time. All game equipment has been drawn to this scale.

2. GAME EQUIPMENT

Each player must be provided with the following equipment:

1 Playing Area Sheet (1 meter by 1 meter) - White Tracing Paper
1 Acetate Overlay (1 meter by 1 meter)
1 Ship Movement Gauge (Figure 2)
1 Weapons Range Gauge (Figure 1)

In addition, the surface player must have:

1 Torpedo Acquisition Gauge (Figure 3)
1 Air Unit Movement Gauge (Figure 4)

The umpire must have all of the above equipment, a Range Gauge (Figure 5) and a Sonar Evaluation Template (Figure 6). All of these are presented in the rules. These can be copied and mounted on hard cardboard.

The rules include the necessary information for play in a series of tables and figures. These are:

TABLE I:	NON-ACOUSTIC DETECTION TABLE
TABLE II:	HULL SONAR SYSTEM TABLE
TABLE III:	HTAS SYSTEM TABLE
TABLE IV:	SONOBOUY SYSTEM TABLE
TABLE V:	SHIP CHARACTERISTICS TABLE
TABLE VI:	WEAPONS CHARATERISTICS TABLE
TABLE VII:	WEAPONS HIT TABLE
TABLE VIII:	PROBABILITY TABLE
Figure 7:	SHIP CONTROL SHEET
Figure 8:	SUBMARINE PASSIVE DETECTION CURVE

The umpire must have a copy of these tables to evaluate the game.

For each unit in the game, a Ship Control Sheet (Figure 7) must be prepared using the information in Table V. The Ship Control Sheet (SCS) can be prepared locally by copying Figure 7.

The umpire will need two, six-sided dice to evaluate weapons hits.

3. SEQUENCE OF PLAY

Each game is divided into game turns, representing six minutes of real time. These turns are divided into four segments: the Command Phase, the First Umpire Phase, the Movement Phase, and the Second Umpire Phase.

Before the game begins, the umpire ensures that all equipment is ready and all SCS's have been filled out. He gives each player a briefing on the game scenario and objectives. The umpire also centers the acetate overlays on the playing

sheets to ensure accuracy of plotting. The players should be placed so they can only see their own playing area. The game then proceeds through the turn sequence until completion of play.

A. COMMAND PHASE

1. Speed Decision

All units plot the speed that they will move during the movement phase of the current turn in the "SPEED" column on the SCS for each ship. This speed cannot exceed the maximum for the ship or 10 knots backing. All backing speeds are logged as negative numbers.

2. Sensor Decision

Each unit in the game has sensors as described in Table V. On the SCS, the "SENSOR" section is divided into four parts headed "RAD", "SON", "HTAS" and "DPT" for radar, sonar, HTAS and depth respectively. If a hull sonar is operated in the active mode, an "A" is placed under the "SON" column for that turn. If a radar is operated in the active mode, an "A" is placed in the RAD" column for that turn. For the submarines in the game, a "B" is placed in the DPT" column if the ship is below the layer and an "A" is used if the ship is above the layer. If the periscope is up, a "P" is put in the column and the submarine is treated as if it were above the layer. These are the only depths the submarine can operate in during the game. If a surface unit has an HTAS system, on game turn one a "D" is placed in the "HTAS" column

if the system is deployed. If it is not to be used in the game, the column is left blank. For all other sensors, a blank in the column indicates the system is passive for that turn.

3. Weapons Launch Decision

Any ship with a target and a ready weapon may fire that system by logging the number of weapons fired in the "FIRE" column under the appropriate weapons system. Weapons systems not firing during a game turn may reload if they have empty tubes and available reloads by logging the number of tubes to be reloaded in the "LOAD" column of the SCS. The weapons systems are placed in the spaces marked "1", "2", and "3" on the SCS.

4. Air Unit Decision

Any ship with a helicopter onboard, or a helicopter airborne, may launch or recover the unit by placing an "L" or "R" respectively in the column for that unit in the "A/C" section of the SCS.

B. FIRST UMPIRE PHASE

The umpire collects the SCS for all units and the acetate overlays on which the positions of the units and weapons firings are indicated. The umpire uses the SCS to determine the sensor status of the ships and the weapons fired during the Command Phase. The overlays are used to establish relative position of the ships for detection.

1. Sensor Evaluation

The umpire determines the status of each ship's sensors and applies the detection rules to determine if any contacts occur.

2. Weapons Launch Detection Evaluation

The umpire determines if the launch of missiles if detected by any surface units, and evaluates the tracks for all torpedos launched during the Command Phase.

3. Intelligence Plotting

The umpire plots all contacts and lines of bearing detected during the evaluation on the acetate overlay for each player, including all torpedo and missile attacks detected. He provides intelligence concerning targets in accordance with the intelligence rules.

C. MOVEMENT PHASE

1. Ship Movement

Using the ship movement gauge, each unit is moved by the players the average of the current and previous turn speeds on the SCS. If a ship turns, the appropriate turning corner of the gauge is used.

2. Helicopter Movement

The surface player moves an airborne helicopters up to the full length of the Air Unit Movement Gauge (Figure 4). He may also conduct MAD searches using the gauge and drop sonobouys. The helicopter may attack during the movement phase. This is the only exception to firing during the Command Phase.

D. SECOND UMPIRE PHASE

The umpire collects the acetate overlays with the move and weapons firings for that turn and the SCS from the players.

1. Weapons Hit and Damage Evaluation

The umpire determines if any weapons had an opportunity to hit a target and evaluates all possible hits. If a hit is achieved, the damage is assessed according to the weapons rules.

2. Sensor Evaluation

Using the sensor status logged in the Command Phase, the umpire determines detections based on the position of the units at the end of the turn.

3. Intelligence Plotting

The umpire adjusts the SCS to reflect the weapons fired during the turn. The number of ready weapons for the next turn is placed in the "RED" column for the next turn and the number of weapons fired is added to the "EMT" column for the current turn. All detections and lines of bearing are plotted on the acetate overlay. Any weapons hit intelligence is provided. The umpire determines if the game has been completed under the victory conditions and either calls for another game turn or ends the game.

This sequence is followed for all game turns until the game is completed.

4. DETECTION, SEARCH AND INTELLIGENCE

A. NON-ACOUSTIC DETECTIONS

Using Table I and the sensor status for radar on the SCS, the umpire determines the range between any possible surface targets and compares the range to the detection range in Table I. If the range between ships is less than the detection range, a detection occurs. For missiles, the launch point of the missile is used to determine the range.

If a non-acoustic detection is achieved, the umpire plots the position of that detection on the acetate overlay. The same system is used for radar, visual and periscope detections. Air search radar may not detect a missile launch point, but provides only a bearing to the launch point and a detection on the missile, without range information.

B. ACOUSTIC DETECTIONS

All sonar systems are assumed to be passive unless an "A" is logged in the sonar column of the SCS for that turn. The passive systems are evaluated on every turn, regardless of status. The active systems are evaluated only on turns when they are logged in operation. HTAS and sonobouys are always passive.

The submarine player may be either active or passive. If the submarine is passive, Figure 8 is used to evaluate detections. The surface targets are grouped into two classes: CV, LHA, LKA, AOR and CG units are HVU targets and DD, FF and FFG

units are Escort targets. The depth of the submarine is taken from the SCS and the speed of the target is taken from the surface ship SCS. These are compared to Figure 8 to obtain the detection range. If the surface unit is within that range, a detection occurs.

If the submarine sonar is active, in addition to the passive evaluation, the umpire evaluates active detections. A submarine above the layer will detect any surface unit within 10,000 yards. A submarine below the layer will detect any surface unit within 5,000 yards. The surface units will achieve a passive detection on any active submarine sonar within 15,000 yards.

All submarine systems, active and passive, operate at speed of up to 20 knots. If a submarine is operating at a speed of 21 knots or more, the submarine unit has no detection capability for all turns in which its speed is above 20 knots.

Surface sonar detections are evaluated using Tables II, III and IV and one of the four ocean scenarios included in the game. Each scenario contains four propagation loss charts, one for Sonar I Active, one for Sonar 2 Active, one for Sonar 1 and 2 Passive and one for the HTAS and Sonobouy Systems. Each chart contains two loss curves, one for a submarine target above the layer and one for a target below the layer.

The umpire determines the operating mode of the system being evaluated, the class of the target (nuclear or diesel) and the speed of both platforms. For the hull sonar, Table II

is used for Sonar I and Sonar 2. From the appropriate table, the umpire determines the Figure of Merit (FOM) for the system. Using the Sonar Evaluation Template (Figure 6) and the propagation loss curve for the system being evaluated, the umpire determines the detection range by placing the zero marks of the template on the zero range line of the curve. When the top of the template is aligned to the FOM determined, the point at which the curve crosses the template is the maximum detection range for the system. It is possible to have convergence zone detections. In Figure 9, the umpire determined that the hull sonar system, Sonar 1, was operating in the passive mode, with the surface unit moving at 10 knots and a nuclear submarine target moving at 15 knots. From Table II, an FOM of 86 dB was determined. By aligning the template, the umpire determined the maximum detection range for an above the layer target to be 18,000 yards and a below the layer target 10,000 yards. A convergence zone existed from 35,000 to 45,000 yards. If the submarine was at 15,000 yards, it would be detected if it were above the layer and not detected if it were below the layer.

Surface sonar systems in the active mode will be detected passively by submarines at twice the maximum range of the sonar. This is determined by taking the maximum FOM for active sonars from Table II, 93 dB, and establishing the range of detection by the method outlined. Double this range is the counterdetection range of the submarines in the game, if the submarine is at 20 knots or less in speed.

The HTAS and Sonobouy use the same curve to determine detection range.

C. INTELLIGENCE

Once all detections have been evaluated during an umpire phase, the umpire plots all detections on the acetate overlay. For each active detection, acoustic or non-acoustic, the exact location of the contact is plotted on the overlay. This includes the launch point of all missiles launched from within the visual or surface search radar range of any surface ships.

For passive detections, the umpire plots a line of bearing from the detecting ship point to the target, without range data. For the HTAS system, two lines of bearing are plotted for every detection. The first points to the contact and the second line is symmetrical around the course of the ship. The detection provides two lines, one correct and the other on the opposite side of the ship. This bearing ambiguity is inherent in linear systems, such as towed arrays, and must be resolved by correlation with other systems or maneuvering the ship. The sonobouy system provides only detection information. It does not provide a bearing to the target. All torpedos launched during the Command Phase and all missiles launched are reported to the target ship during the First Umpire Phase in the same way as passive detections, bearing only.

Once all detections and weapons launches have been plotted on the overlay, the umpire updates his plot and returns the

overlays to the players. In addition to the position of active contacts and lines of bearing for passive contacts, classification information is provided for some targets.

If a submarine passive or HTAS system holds a target for two consecutive turns, the player is told the target class, HVU or Escort for surface targets and nuclear or diesel for submarines. On the third turn of contact, the player is given an estimated range to the target in bands, starting at zero. The submarine player is given the range in 10,000 wide bands and the surface player is given the range in 15,000 yard wide bands. The umpire would say, "You have a surface HVU contact between 20,000 and 30,000 yards," in the case of a submarine contact. All targets beyond 45,000 yards are reported as "distant" targets.

The sonobouy system can provide classification data on targets that are held for two or more turns. The same information as is provided by the HTAS is received for a sonobouy contact.

5. MOVEMENT

During the Movement Phase, the players move all units in the game at a speed equal to the average of the speeds logged on the SCS for the current and previous game turns. If no speed change is made, the speed on the SCS for the current turn is this value. If a change is made, the average is taken by adding the speed on the SCS for the current and preceding turn and dividing by two. For example, a speed of 20 knots

on turn 4 and 30 knots on turn 5 would yield a speed of movement of 25 knots on turn 5. The units must move the full amount required by the rules. For sensor decisions, however, the speed logged on the SCS for the current turn is used. This system prevents units from making radical maneuvers to avoid weapons launched in the Command Phase and detected during the First Umpire Phase.

The ship movement gauge (Figure 7) is used to move all units. The gauge is divided into a straight movement side, divided into one knot intervals up to ten knots and five knots intervals up to 30 knots, and three turning corners, with one knot marks on the edges. Submarines use the "SS" corner, Escorts use the "DD" corner and HVU's use the "HVU" corner.

Units with HTAS deployed are limited to 20 knots maximum speed. Also they must move at least five knots at all times and cannot log a backing speed, even if the average speed remains above five knots. If these limits are exceeded, the HTAS unit is lost for the remainder of the game.

6. WEAPONS EVALUATION AND DAMAGE

All weapons firing decisions are made during the Command Phase, with the exception of air-dropped weapons, which are covered in the Helicopter rules. The players log the number of weapons fired under the correct system and plot the weapons tracks during the Command Phase, using the Weapons Range Guage (Figure 1). One side of the gauge is marked off in

one minute intervals for torpedo runs and the other side has the range limits for the RTT system and the SS-N-1 system.

The number of weapons fired from a system is logged in the "FIRE" column of the SCS under the system firing. All ships may attack only one target per game turn and may fire only one system per game turn, with the exception of the SSGN submarines, which may fire both torpedos and missiles during a game turn, each system at a single target. When a system is fired, the player may fire as many tubes as are ready in that system up to the maximum number indicated for that system in Table VI. The RTT system, however, may only fire two weapons during a game turn, both against the same target.

To fire on a target, the firing unit must have contact on the target with some sensor, active or passive. A surface unit may not fire on a target held on sonobouys, but may fire on targets held on passive systems. Ships with the TDS system may fire on targets held by other TDS ships, if the ship holding contact has held the target for three consecutive turns prior to the attack. If a weapon meets all other criteria for a hit on a target but the firing unit does not hold contact with that target on a sensor system or through a TDS link, the hit probability of the weapon is .00 in all cases.

During a turn in which a system is not fired, empty tubes in the system may be reloaded if there are reloads available. Orange missiles may not be reloaded. To load a system, the player places the number of tubes to be reloaded in the "LOAD"

column, with a maximum of two per game turn, decreasing the tubes in the "EMT" column by that number. During the Second Umpire Phase, the umpire adds all reloads to the ready column and places that number in the ready column for the next turn. If weapons were fired during that turn, the number fired is subtracted from the ready column for the turn, and the number of ready tubes remaining placed in the ready column for the next turn. The number of missiles or torpedos fired is added to the empty column. A system may not fire or reload more tubes than the system has, as shown in Table V. In any game turn, a system may reload or fire, but not both.

A. WEAPONS PLOTTING AND MOVEMENT

Weapons Plots are made during the Command Phase of the game. The track is considered movement, however, and evaluated during the Second Umpire Phase. For both deck launched torpedos and submarine torpedos, a line is drawn from the position of the firing ship at the start of the turn, using the range gauge. For submarine T-1 torpedos, the line is drawn to the "6" mark on the gauge. For the tube-launched ASW Torpedos (ASWT), the line is drawn to the "5" mark on the gauge. One track line is drawn for each weapon launched and the lines are divided into one minute segments using the range gauge. For the ASWT, the surface player also marks on the track line the depth of the torpedo, "A" for above the layer and "B" for below the layer. These lines are drawn by

the player to attempt to intercept the movement of the target unit during the Movement Phase.

The rocket-thrown torpedo (RTT) system uses the range gauge to mark its range of firing. The system may fire one or two weapons per turn. The splash point of the weapons is marked on the playing area sheet and the Torpedo Acquisition Gauge (Figure 3) is used to draw a detection circle centered on the splash point. The splash point must be between the minimum and maximum ranges of the RTT, as indicated on the gauge. If two weapons are fired, one weapon is assumed to be at each depth level. If only one weapon is fired, the depth of the weapon must be indicated on the playing area sheet in the detection circle.

The SS-N-1 missile system has a minimum range of 6,000 yards and a maximum of 60,000 yeards. All missiles fired in a turn travel down a single track, drawn from the position of the firing submarine at the beginning of the turn. The submarine player can set the activation range of the missiles at from 6,000 to 30,000 yeards. The missile will attack the first target it detects past the activation range. This allows the submarine player to shoot over close targets to hit others of higher value.

B. HIT EVALUATION AND DAMAGE

During the Second Umpire Phase, the umpire compares the track of all weapons fired during the turn with the movement

of the ships during that turn, determining the opportunities for hits.

For the T-1 torpedo, if a ship track crosses a torpedo track during a turn, the umpire determines if the ship and torpedo crossed during the same minute of the turn by dividing the ship movement track into one minute segment, like the torpedo track. If this occurs, the umpire rolls the dice and refers to Tables VII and VIII to determine if a hit has been received by the surface unit.

For the ASWT TT system, the umpire uses the Torpedo Acquisition Gauge (Figure 3) to determine the possibility of hits. The template is placed on the torpedo track, centered on the minute marks of the track. If a submarine enters the detection circle of the gauge during the turn, an attack occurs. The umpire determines the depth of the torpedo and the depth of the target and uses Tables VII and VIII again to determine hits.

The RTT system will attack any submarine target that enters the circle drawn during the Command Phase during the Movement Phase of the turn. The system will attack with both weapons if two were fired.

Both the ASWT TT and RTT system will attack only one target per turn, no matter how many enter the acquisition circle. The umpire must decide which target was first to enter the circle and that is the target attacked. If an ASWT or RTT misses, it is considered out of the game.

The SS-N-1 missile will attack the first target past the activation range noted on the track during the Command Phase. For the missile to attack, the target must be within 5,000 yards of the missile track. If a ship is attacked by a missile, all missiles fired during that turn attack the same ship, even if the first missile put the ship out of action. The hit probabilities in Tables VII and VIII are used to evaluate missile hits on the specific class of ship that is the target. The SS-N-1 is launched from a submerged submarine with a depth above the layer.

If a submarine of surface escort ship receives a hit during a turn, that unit is considered out of action for the remainder of the game and is removed from play. If an HVU unit takes a missile hit, it receives one damage point. A torpedo hit causes two damage points. It takes four total damage points to put an HVU ship out of action.

6. HELICOPTERS

Certain units are capable of carrying an ASW helicopter (ASWH). These helicopters carry 15 sonobouys, 2 ASWT and have radar and magnetic anomoly detectors (MAD).

A. MOVEMENT

Helicopters are moved during the Movement Phase using the Air Unit Movement Gauge (Figure 4). Each turn is divided into four parts.

To launch a helicopter, the surface player puts an "L" in the column for the helicopter in the "A/C" section of the

SCS during the Command Phase. During the Movement Phase, the ship must move in a straight line, with no turns of any kind. At the end of the movement, the helicopter is considered airborne. If the ship cannot move on a straight course, the launch is considered aborted and the helicopter still onboard. To land a helicopter, the player puts an "R" in the column for the unit. During the movement portion of the turn, the ship must again move on a straight course. The helicopter must have started the landing turn within 5,000 yards of the recovering ship to land. A helicopter may remain airborne 15 turns, counting both the landing and recovery turns.

While airborne, a helicopter may move in any direction up to the maximum on the movement gauge. It may drop sonobouys during the movement phase by marking the position of the sonobouys dropped on the playing sheet and overlay, numbering the bouys dropped consecutively from 1 to 15. A helicopter may also conduct MAD searches during the movement phase by drawing a circle around the helicopter's position using the circle on the movement gauge. Each MAD search expends one quarter of the helicopter's movement for that game turn.

B. SEARCH

Helicopters may search using visual or radar in the same manner as surface units. They may also use MAD and sonobouys.

During each turn in which a helicopter is airborne and has bouys in the game, the surface player may receive

information from up to four bouys per helicopter, with a maximum of one helicopter per ship sending data. If more than four bouys have been dropped during the game, the surface player must decide which four bouys are active. Once the surface player has decided which four bouys will be monitored, all other bouys are considered out of play and cannot be used again during the game. If additional bouys are dropped on subsequent turns, the surface player must again decide which four bouys will be monitored for the turn. This decision is made prior to the Second Umpire Phase. All inactive bouys are crossed out on the acetate overlay and playing area sheet.

The umpire evaluates up to four bouys for an airborne helicopters during the umpire phases. If more than one helicopter is airborne from a single ship, the surface player must designate which helicopter's bouys will be monitored during that game turn. The acoustic detection of the bouys is evaluated in the same way as the HTAS system, using target type and speed. No bearing information is provided by a sonobouy, if a detection occurs. The surface player is told only that the bouy is active, by number, and on the second turn of contact is given the class of the target.

MAD searches are conducted during the movement portion of the turn. The surface player draws a detection circle centered on the helicopter's position. If a submarine enters the detection circle while the helicopter is searching, a

detection occurs. Each MAD search last one quarter of a turn, or 90 seconds of real time. The umpire must decide if a target and search coincide.

If a MAD contact is gained, the umpire informs the surface player of the detection. This would occur during the Second Umpire Phase. If the surface player wishes, he may launch an attack dropping one or two ASWT at the location of the helicopter, if the helicopter has weapons left. The procedure is the same as an RTT shot. The Torpedo Acquisition Gauge is used to draw a circle centered on the helicopter's position. If the submarine enters this circle after the weapon is launched, an attack is evaluated using Tables VII and VIII. If two ASWT are dropped, one is considered to be at each depth level. If only one is dropped, the surface player must designate the depth of the ASWT. This is the only exception to weapons being fired during the Command Phase. All air dropped ASWT are considered expended at the end of the turn, regardless of when they were dropped during the Movement Phase.

7. SCENARIOS AND SUGGESTED GAMES

Four ocean area scenarios are provided in the game, one Mediterranean, one Atlantic, and two Pacific locations. These scenarios contain the sound velocity profile for the location and four propagation loss charts for acoustic detection evaluation. The umpire will select the scenario to be used for the game, ensuring that all charts are for the same location.

Four games are suggested for beginning play, using any scenario. This provides 16 games for possible use.

GAME 1

BLUE FORCES	ORANGE FORCES
DD with 1 ASWH	SSN

Initial Positions

The DD starts in the western half of the playing area, the submarine starts in the eastern half of the sheet, below the layer.

Victory Conditions

Peacetime Game: The Blue player wins by gaining and holding contact on the Orange unit for four consecutive turns. The Orange player wins by avoiding these conditions.

Wartime Game: The player who puts the opposing unit out of action wins.

GAME 2

BLUE FORCES	ORANGE FORCES
CV or LHA	SSGN or SSN
FFG with 2 ASWH	

Initial Positions

The HVU unit begins the game on the eastern or western edge of the playing area and must transit across the board. The FFG is placed in a screening position by the surface player. The submarine unit begins the game within 20,000 yards of the playing sheet center, below the layer.

Victory Conditions

Peacetime Game: The Blue player wins by transitting the HVU and preventing the submarine from closing to within 10,000 yards of the HVU and remaining undetected for three consecutive turns. The game ends as soon as the submarine has been within 10,000 yards of the HVU undetected for three turns, or the HVU exits the board. The maximum speed of the HVU is limited to 15 knots.

Wartime Game: The Blue player wins by crossing the board with the HVU still in action. The Orange player wins by putting the HVU out of action.

GAME 3

BLUE FORCES	ORANGE FORCES
AOR	SSGN or SSN
DD with 1 ASWH	
FF with 1 ASWH	

Initial Positions

The HVU starts in a box 10,000 yards on a side, with the umpire placing this box anywhere on the board. The HVU must remain in this box. The escorts are deployed by the surface player to screen the HVU. The Orange submarine enters the board from any side, above the layer.

Victory conditions

Peacetime Game: The Orange player gets one point for each time it detects the HVU using the periscope. The Blue

player gets one point for detecting the submarine and localizing its position prior to the submarine sighting the HVU. The game is played in a series of runs. Once one player has received a point, the game begins again.

Wartime Game: The Blue player wins by sinking the Orange unit and having one escort and the HVU still in action. The Orange player wins by sinking the HVU or both escorts.

GAME 4

BLUE FORCES	ORANGE FORCES
FF with 1 ASWH	SS

Initial Positions

Both players chose their own starting positions and plot them for the umpire. The submarine may start at any depth.

Victory conditions

Peacetime Game: The Orange player wins by closing to within periscope range of the FF without being localized. The Blue player wins detecting and localizing the submarine.

Wartime Game: The player who puts the opposing unit out of action wins.

GAME SEQUENCE REFERENCE

A. COMMAND PHASE

1. SPEED DECISION
2. SENSOR DECISION
3. WEAPONS LAUNCH DECISION
4. AIRCRAFT LAUNCH DECISION

B. FIRST UMPIRE PHASE

1. SENSOR DETECTION EVALUATION
2. WEAPONS LAUNCH DETECTION EVALUATION
3. INTELLIGENCE PLOTTING

C. MOVEMENT PHASE

1. SHIP MOVEMENT
2. AIRCRAFT MOVEMENT

D. SECOND UMPIRE PHASE

1. WEAPONS HIT EVALUATION
2. WEAPONS DAMAGE EFFECT EVALUATION
3. SENSOR DETECTION EVALUATION
4. INTELLIGENCE PLOTTING PHASE

TABLE I

NON-ACOUSTIC DETECTION

Visual (NM)

Target

Platform	Ship	Periscope	Aircraft	Helo	Missile
Ship	15	5	15	10	15/5*
Periscope	10	-	5	5	-
Aircraft	35	5	10	10	5
Helo	25	5	10	10	5

*Launched Inside 15NM/Launched Outside 15NM

Radar (NM)

Target

Platform	Surface/Periscope	Aircraft/Missile
Surface Search	25/20	30/25
Air Search	0/0	80/11
Helo	25/5	15/15

TABLE II

HULL SONAR SYSTEM

ACTIVE FIGURE OF MERIT

Platform Speed (KTS)

	0-10	11-15	16-20	21-25
Target				
SSBN/SSGN	93	91	87	83
SSN/SSG/SS	88	86	82	78

PASSIVE FIGURE OF MERIT

Target Speed (KTS)

Diesel

Platform Speed (KTS)	0-3	4-6	7-10	11+	SNORK
0-10	68	68	84	89	90
11-15	60	60	76	81	82
16-20	60	60	70	75	76
21-25	60	60	64	69	70

Nuclear

	0-5	6-10	11-15	16+
0-10	75	82	86	90
11-15	67	74	78	82
16-20	60	68	72	76
21-25	60	62	66	70

SONAR 1 - Active-3.0kHz Passive-1.9kHz
SONAR 2 - Active-6.0kHz Passive-1.9kHz No Active CZ

TABLE III

HTAS SYSTEM

PASSIVE FIGURE OF MERIT
(50-150 Hz)

DIESEL TARGET

Target Speed (KTS)	Platform Speed (KTS) 5-10	11-15
0-3	65	60
4-6	80	75
7-10	84	79
11+	90	85
SNORK	92	87

NUCLEAR TARGET

Target Speed (KTS)	Platform Speed (KTS) 5-10	11-15
0-5	73	68
6-10	85	80
11-15	88	83
16+	90	85

Minimum Tow Speed - 5 Knots

Maximum Tow Speed - 20 Knots NO BACKING WITH HTAS DEPLOYED

TABLE IV

SONOBOUY SYSTEM

PASSIVE FIGURE OF MERIT
(50-150 Hz)

DIESEL TARGET

Target Speed (KTS)	
0-3	62
4-6	72
7-10	79
11+	88
SNORK	90

NUCLEAR TARGET

Target Speed (KTS)	
0-5	73
6-10	81
11-15	86
16+	90

TABLE V

SHIP CHARACTERISTICS

BLUE SHIPS (SURFACE)

CLASS	MAX SPEED	SONAR	HTAS	TDS	AIRCRAFT	WEAPONS
CV	34	NO	NO	NO	NO	NO
LHA/AOR/LKA	25	NO	NO	NO	NO	NO
CG	34	1	NO	YES	NO	2xRTT/6 3xTT 3xTT
DD	30	1	NO	YES	2xASWH	8xRTT/8 3xTT/6 3xTT/6
FF	27	1	NO	NO	1xASWH	8xRTT/8 2xTT/4 2xTT/4
FFG	27	2	YES	NO	2xASWH	3xTT/6 3xTT/6

ORANGE SHIPS (SUBMARINE)

CLASS	MAXIMUM SPEED	SONAR	WEAPONS	COMMENTS
SSGN	30	SUB	8xSS-N-1 6xTT/12	Submerged launch missile
SSN	30	SUB	6xTT/12	
SS	18	SUB	6xTT/12	

Number of tubes ←Number of reloads
6xTT/12
Weapons System

ASWH - Antisubmarine Warfare Helicopter
RTT - Rocket-Thrown Torpedo
TT - Torpedo Tube Battery
TDS - Tactical Data System

TABLE VI

WEAPONS CHARACTERISTICS

BLUE WEAPONS

DESIGNATION	SPEED	MIN RNG	MAX RNG	PLATFORM
ASW TORPEDO	45	0	7500	Surface Torpedo Tube
ASW TORPEDO	45	0	1200*	Air Dropped/RTT

*This range is the acquisition range of the torpedo. The torpedo conducts a circular search at the point it enters the water.

ORANGE WEAPONS

DESIGNATION	SPEED	MIN RNG	MAX RNG	PLATFORM
SS-N-1	NA	6000	60000	SSGN Submerged Launch
T-1	45	0	9000	SSGN, SSN, SS Torpedo Tube

AIR UNITS

DESIGNATION	SPEED	ENDURANCE	WEAPONS	SENSORS	PLATFORM
ASWH	100	90 MIN	2xASWT	15xSono-bouy Radar	FFG, FF, DD

TABLE VII

WEAPONS HIT TABLE

	WEAPON		
	SS-N-1	T-1	ASWT
TARGET			
CV/LHA	.5	.5	-
AOR/LHA	.65	.5	-
CG	.5	.5	-
DD	.6	.5	-
FF	.6	.5	-
FFG	.45	.5	-
SSGN/SSN/SS	-	-	.5/.2*

*IN LAYER/CROSS LAYER

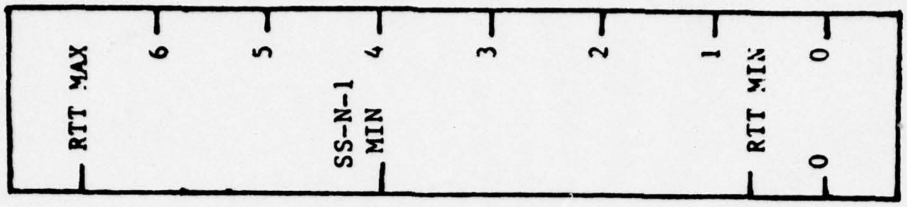
HVU Damage Points

WEAPON	POINTS
SS-N-1	1
T-1	2

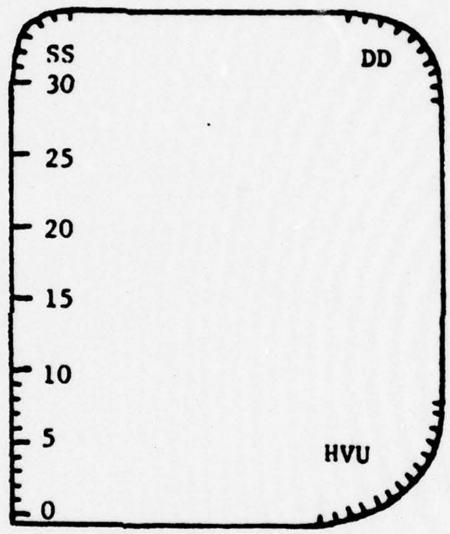
TABLE VIII

PROBABILITIES RESULTING FROM SINGLE ROLL OF TWO REGULAR DICE

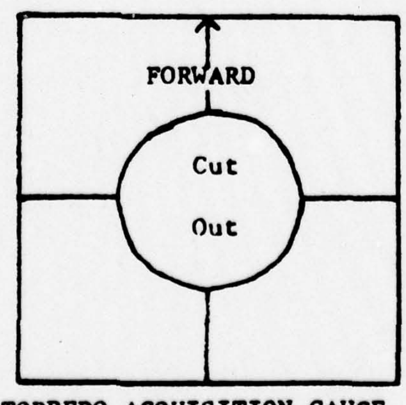
PROBABILITY	VALUE OF THROW
.05	3
.10	5
.15	3 or 4
.20	2 or 7
.25	2, 3 or 7
.30	6 or 7
.35	3, 6 or 7
.40	2, 4, 5, 6 or 12
.45	2, 3, 4, 5, 6 or 12
.50	2, 4, 5, 6 or 8
.55	2, 3, 4, 5, 6 or 8
.60	2, 4, 5, 6, 7 or 10
.65	2, 3, 4, 5, 6, 7 or 11
.70	2, 4, 5, 6, 7, 8 or 12
.75	2, 3, 4, 5, 6, 7, 8 or 12
.80	2, 4, 5, 6, 7, 8, 9 or 12
.85	2, 3, 4, 5, 6, 7, 8, 9 or 12
.90	2, 4, 5, 6, 7, 8, 9, 10 or 12
.95	2, 3, 4, 5, 6, 7, 8, 9, 10 or 12
1.00	2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12



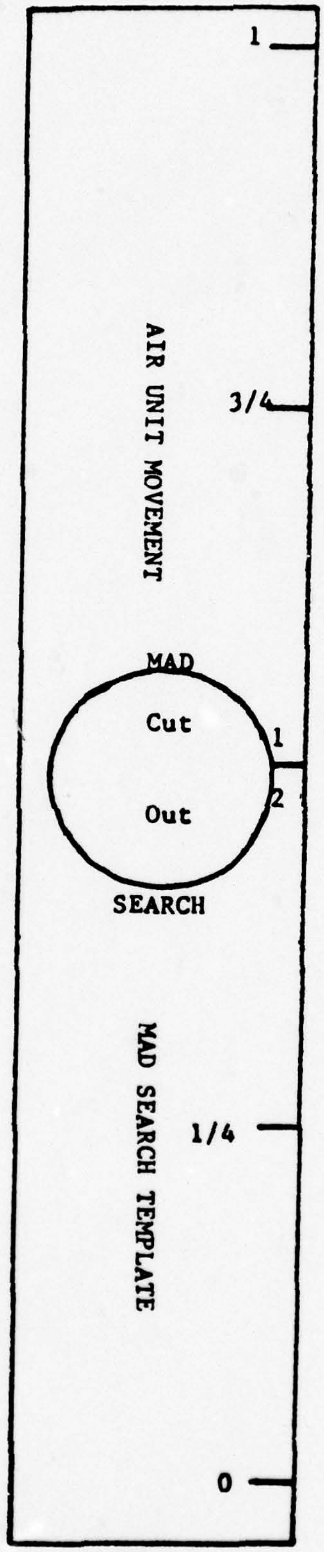
WEAPONS RANGE GAUGE
Figure 1



SHIP MOVEMENT GAUGE
Figure 2



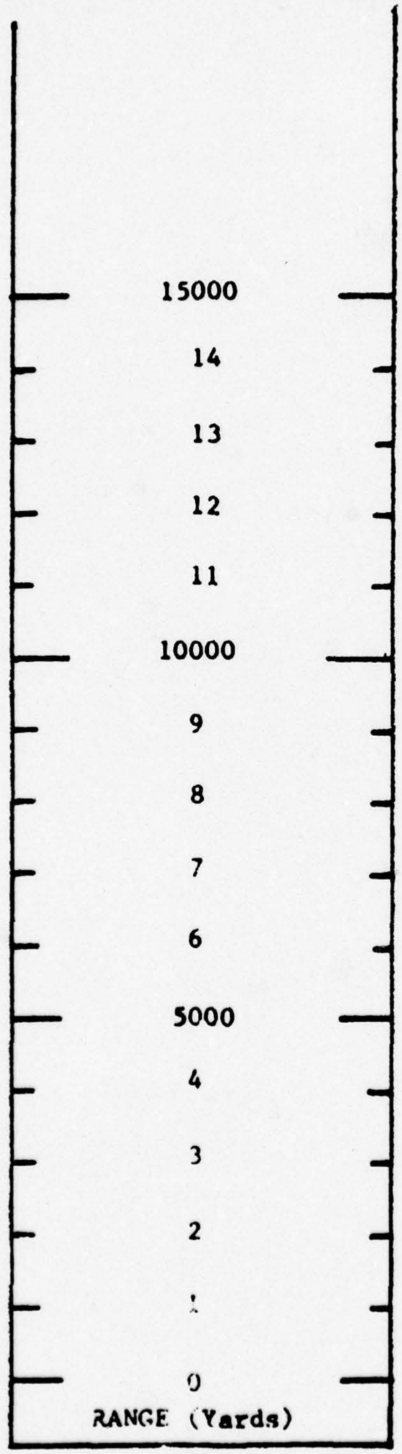
TORPEDO ACQUISITION GAUGE
Figure 3



AIR UNIT MOVEMENT GAUGE

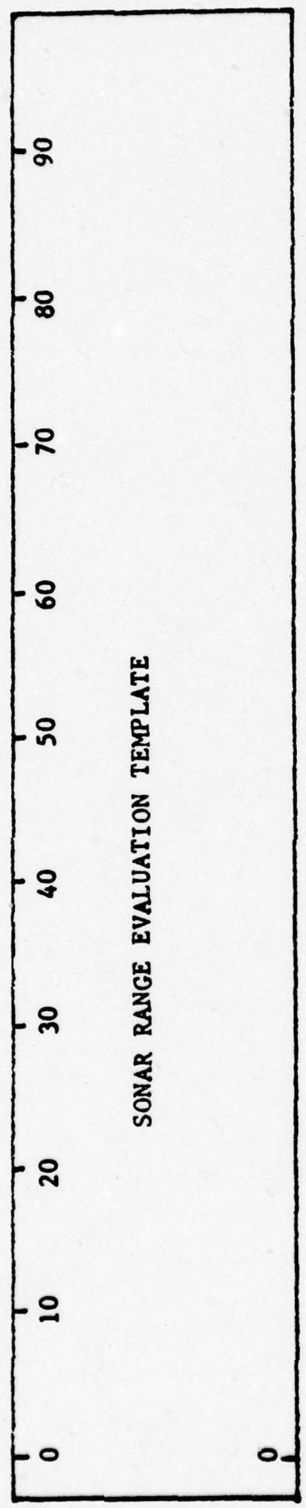
Figure 4

Extend range gauge out to 60,000 yards at 5000 yard intervals. (A meter stick can be used for the range gauge if available)



RANGE GAUGE

Figure 5



SONAR RANGE EVALUATION GAUGE

Figure 6

CLASS	SHIP	MAX SPD
SONAR	ARRAY	AIRCRAFT

TURN	SPEED	SENSOR				1:				2:				3:				A/C	
		RAD	SON	HTAS	DPT	FIRE	RED	LOAD	EMT	FIRE	RED	LOAD	EMT	FIRED	RED	LOA	EMT	1	2
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			

MGZ 1				MGZ 2				MGZ 3			

SHIP CONTROL SHEET
Figure 7

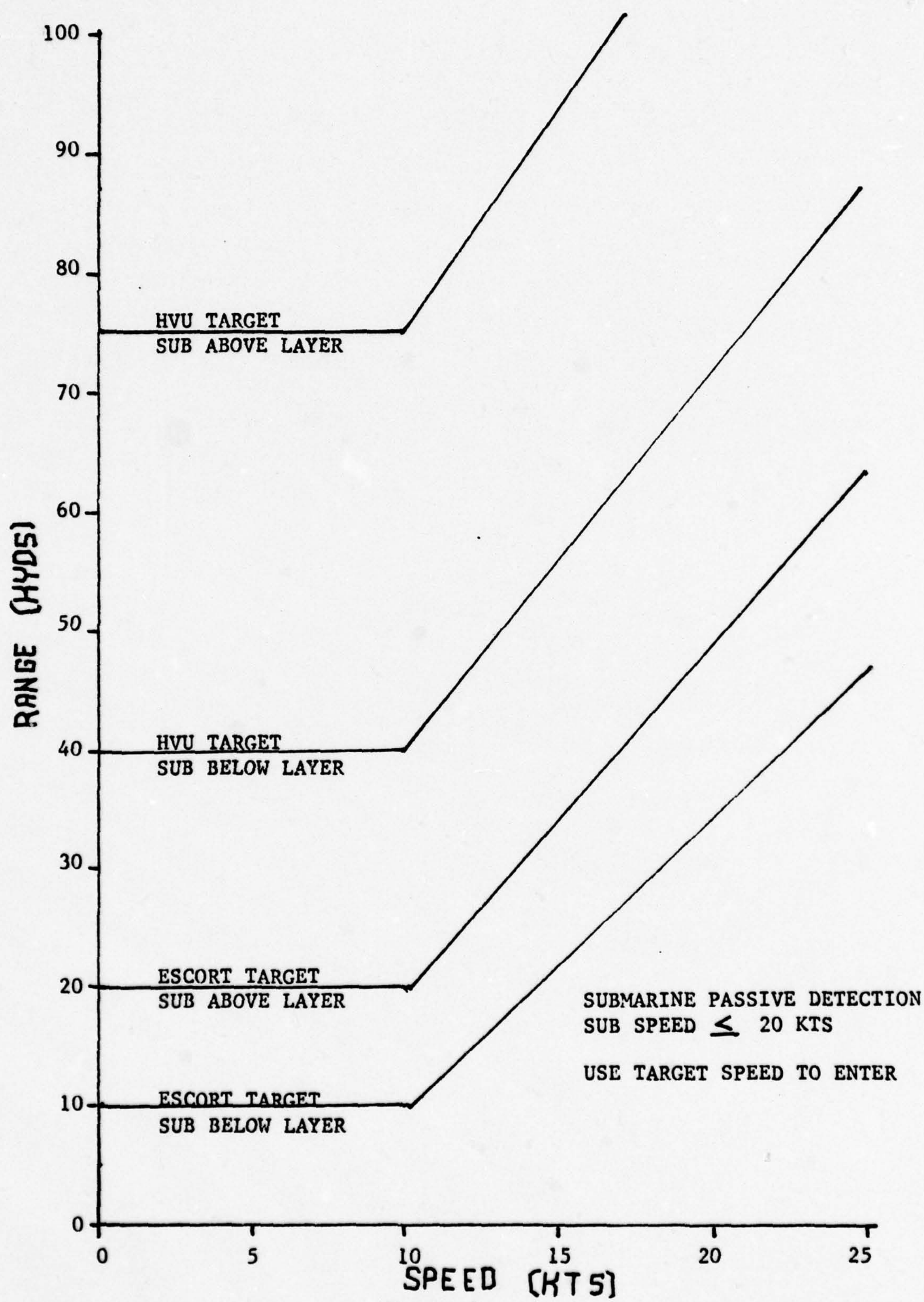

RANGE (KYDS)
100
90
80
70
60
50
40
30
20
10
0
HVU TARGET
SUB ABOVE LAYER
HVU TARGET
SUB BELOW LAYER
ESCORT TARGET
SUB ABOVE LAYER
ESCORT TARGET
SUB BELOW LAYER
SUBMARINE PASSIVE DETECTION
SUB SPEED ≤ 20 KTS
USE TARGET SPEED TO ENTER
0
5
10
15
20
25
SPEED (KTS)

Figure 8

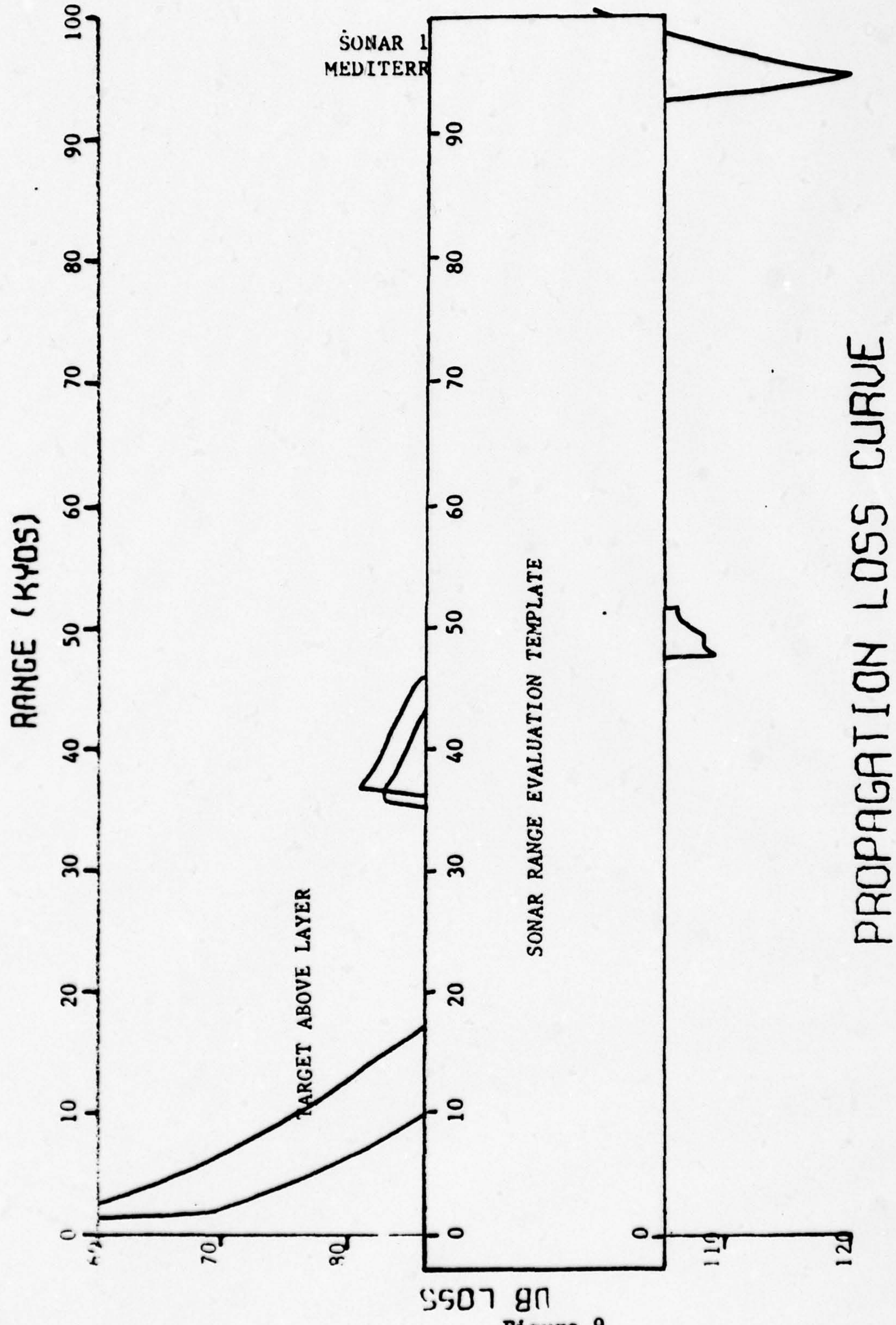
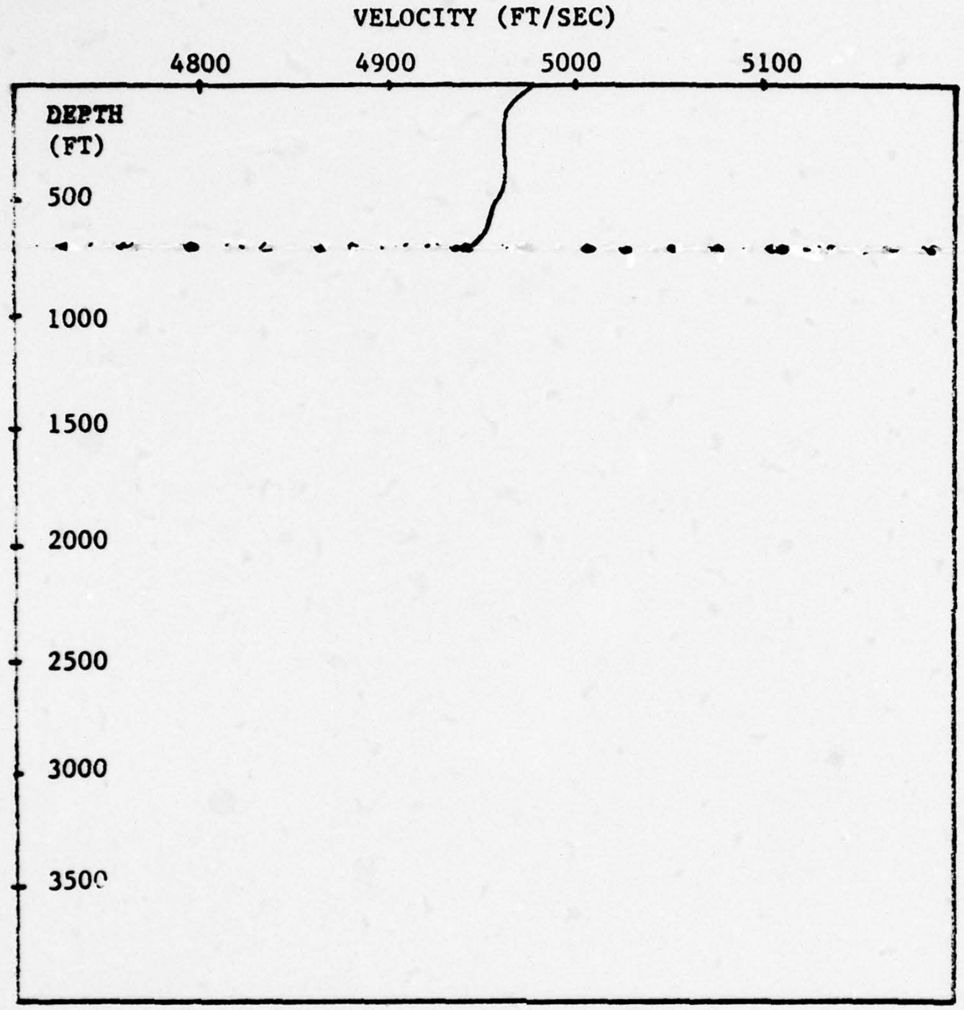
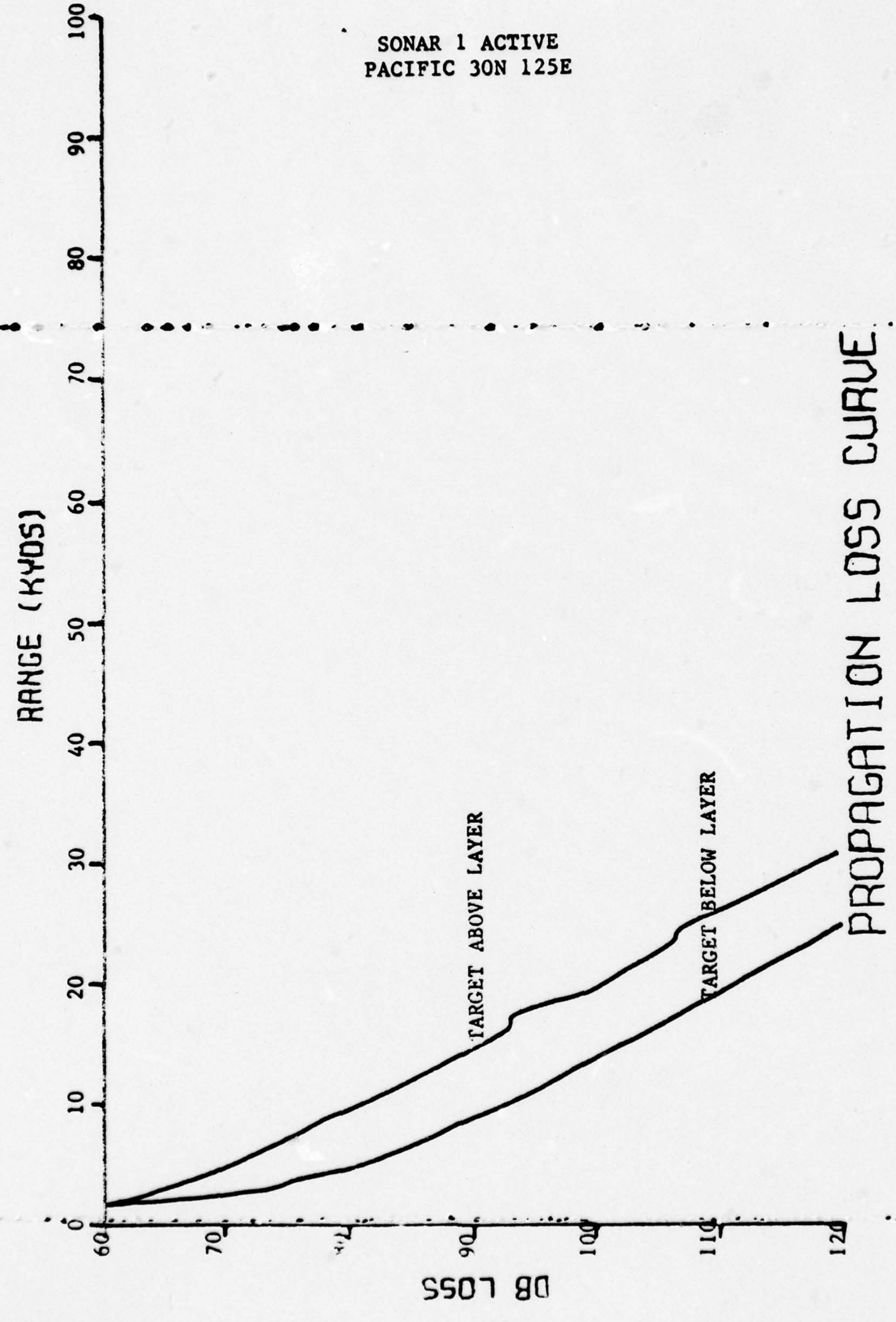

RANGE (KYDS)
PROPAGATION LOSS CURVE
SONAR RANGE EVALUATION TEMPLATE
TARGET ABOVE LAYER
SONAR 1
MEDITERR
DB LOSS

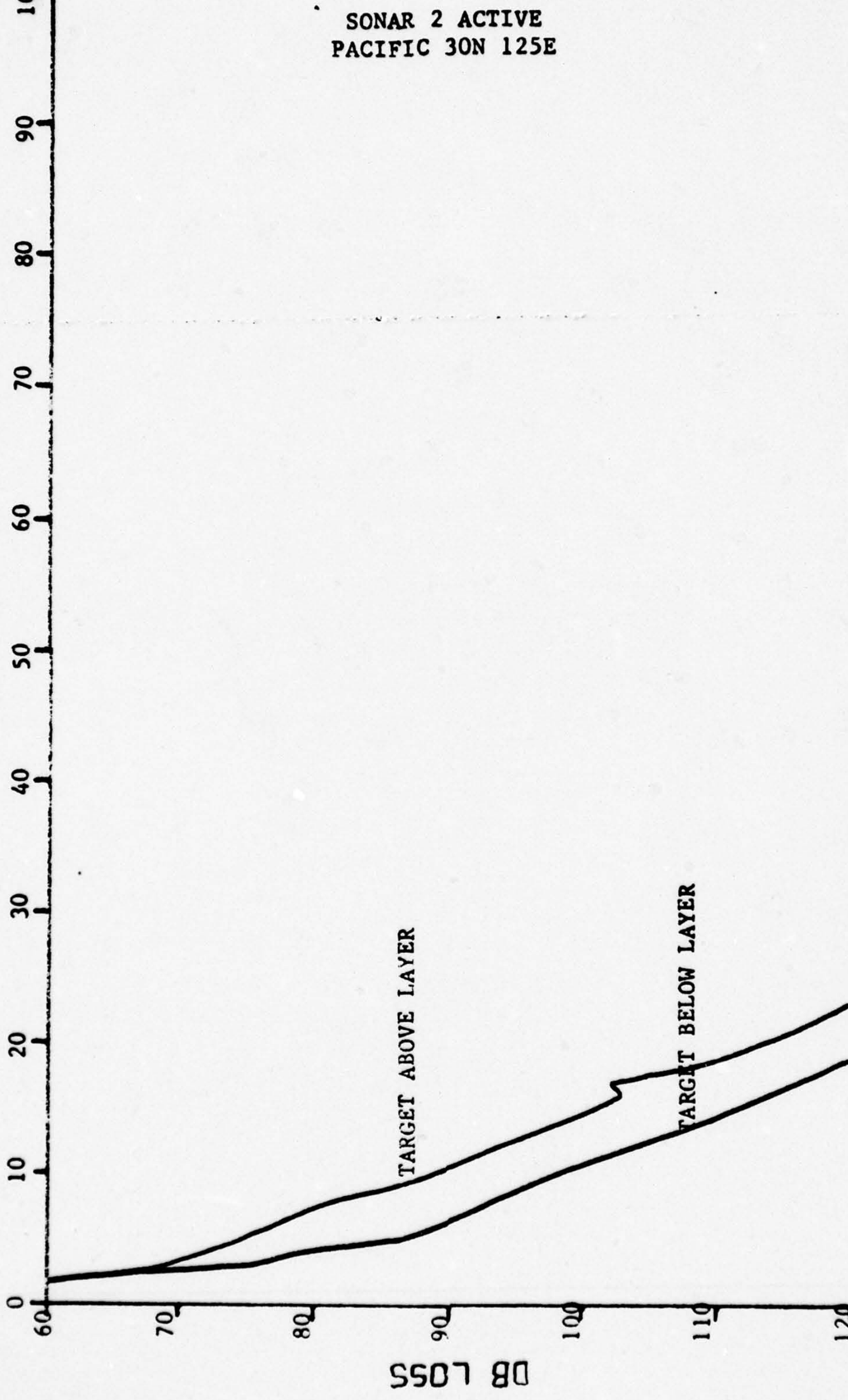
Figure 9

** VELOCITY PROFILE **

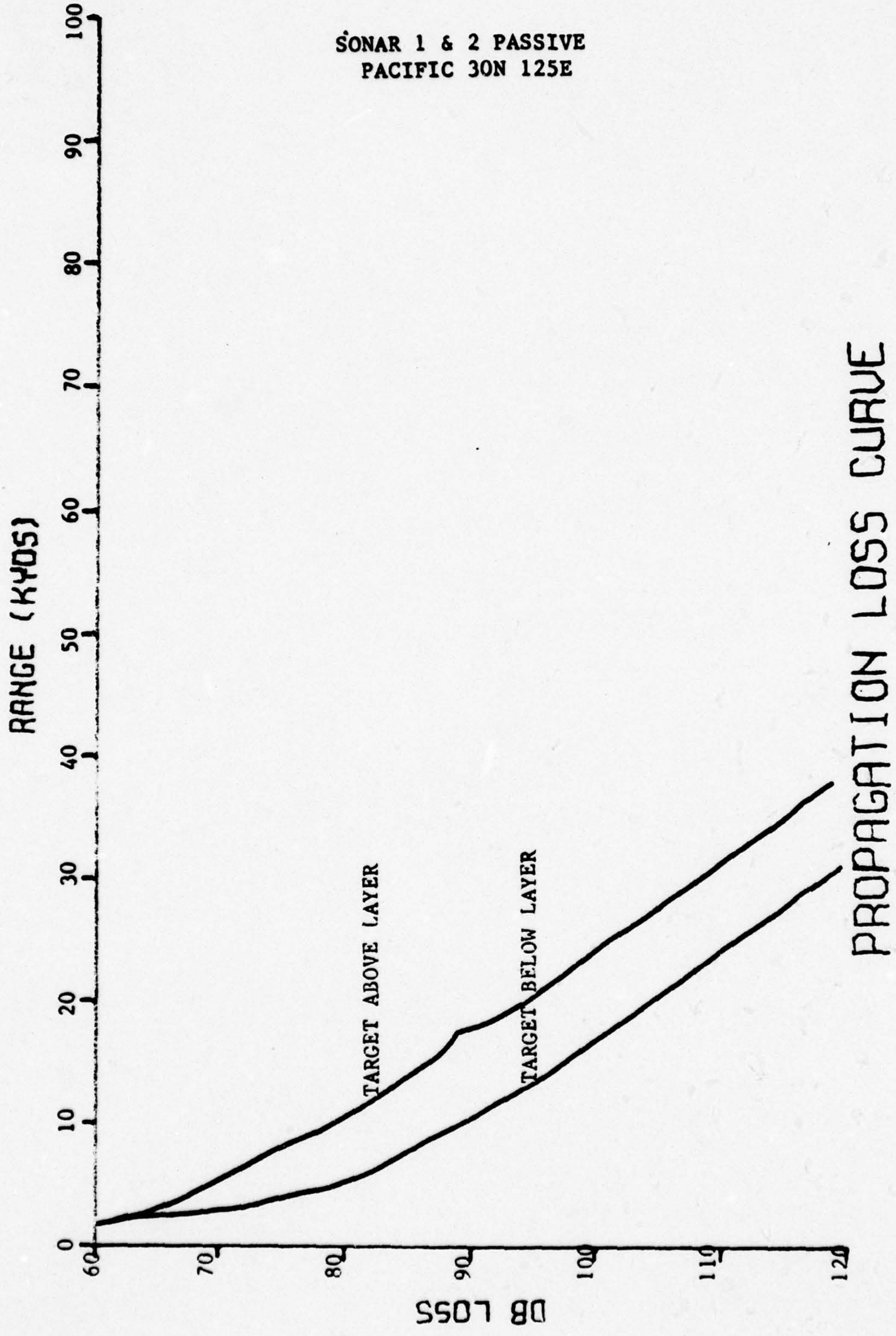


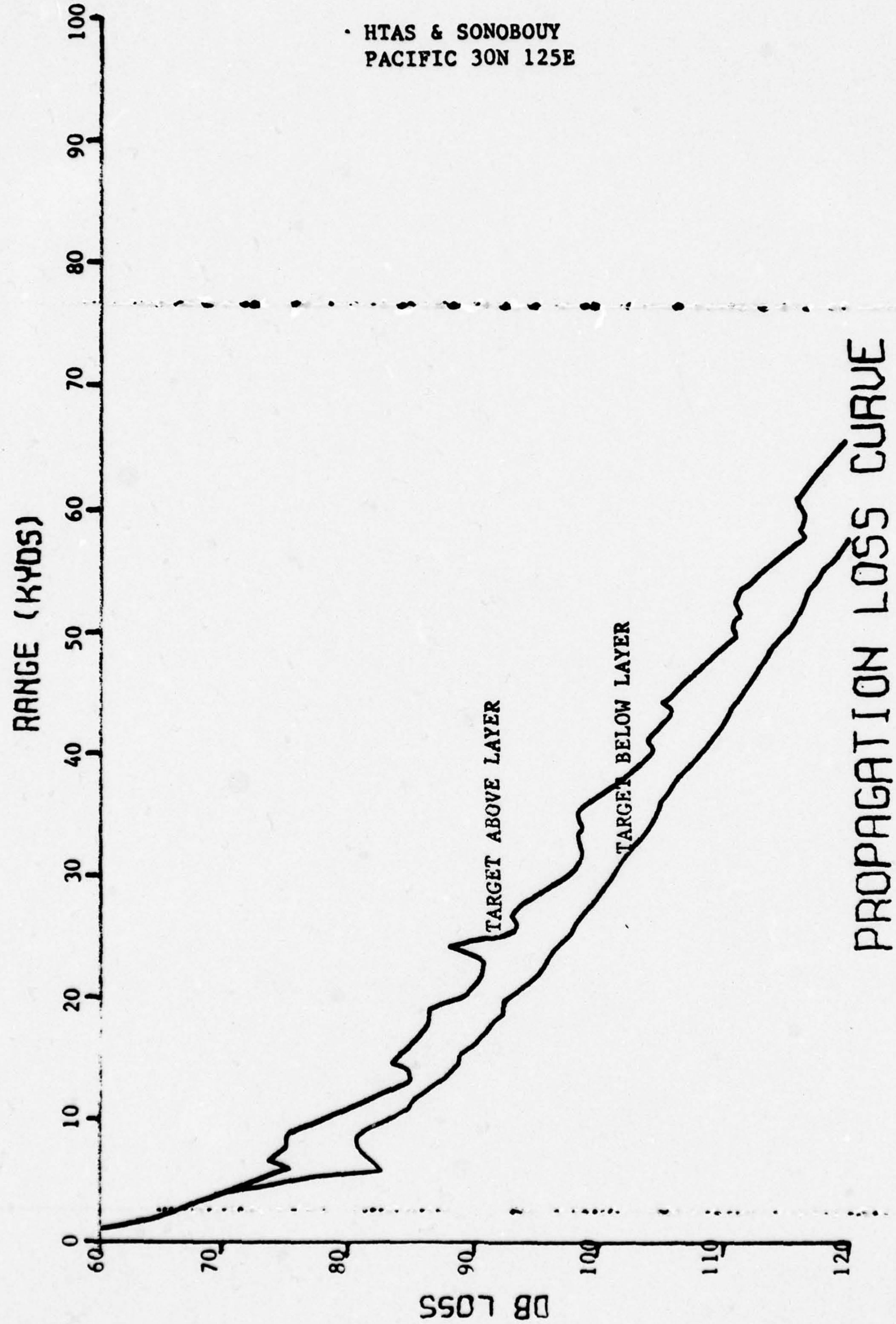
PACIFIC
(30 N 125 E)


SONAR 1 ACTIVE
PACIFIC 30N 125E
RANGE (KYDS)
DB LOSS
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE
0
10
20
30
40
50
60
70
80
90
100
60
70
90
100
110
120

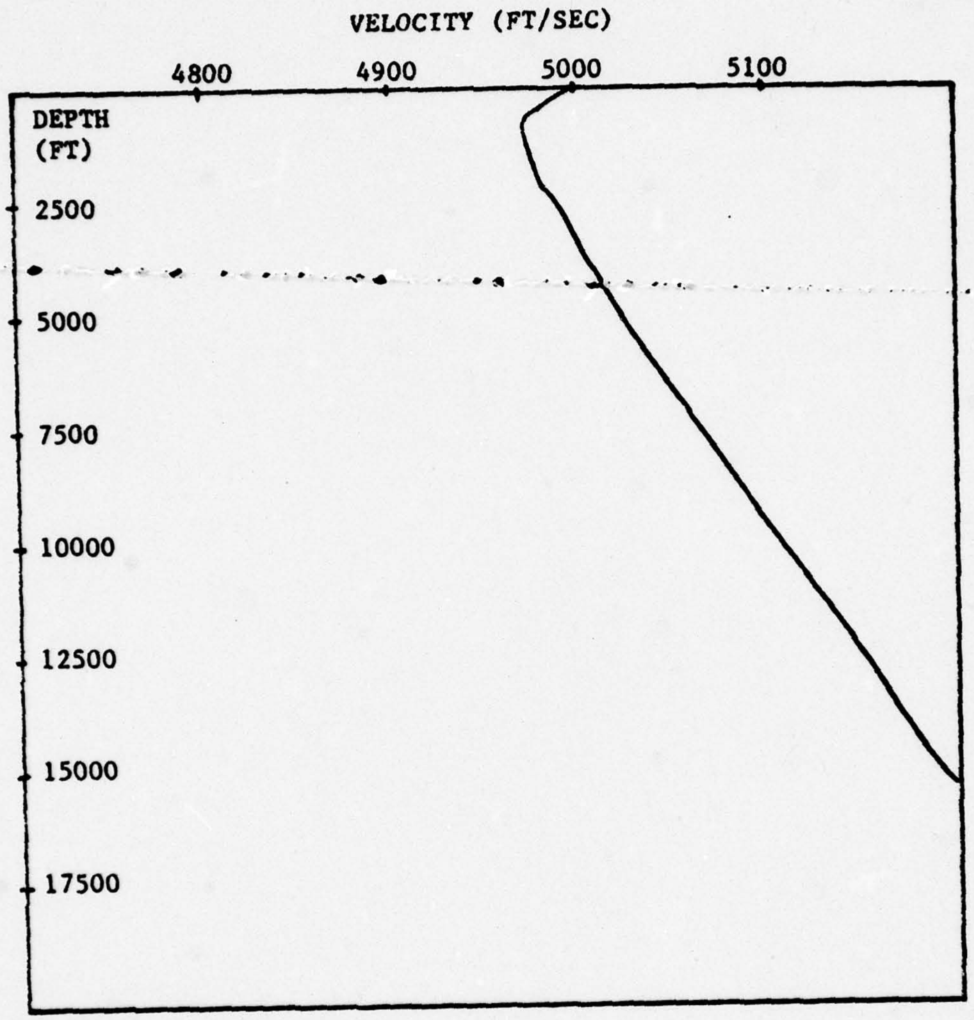


PROPAGATION LOSS CURVE

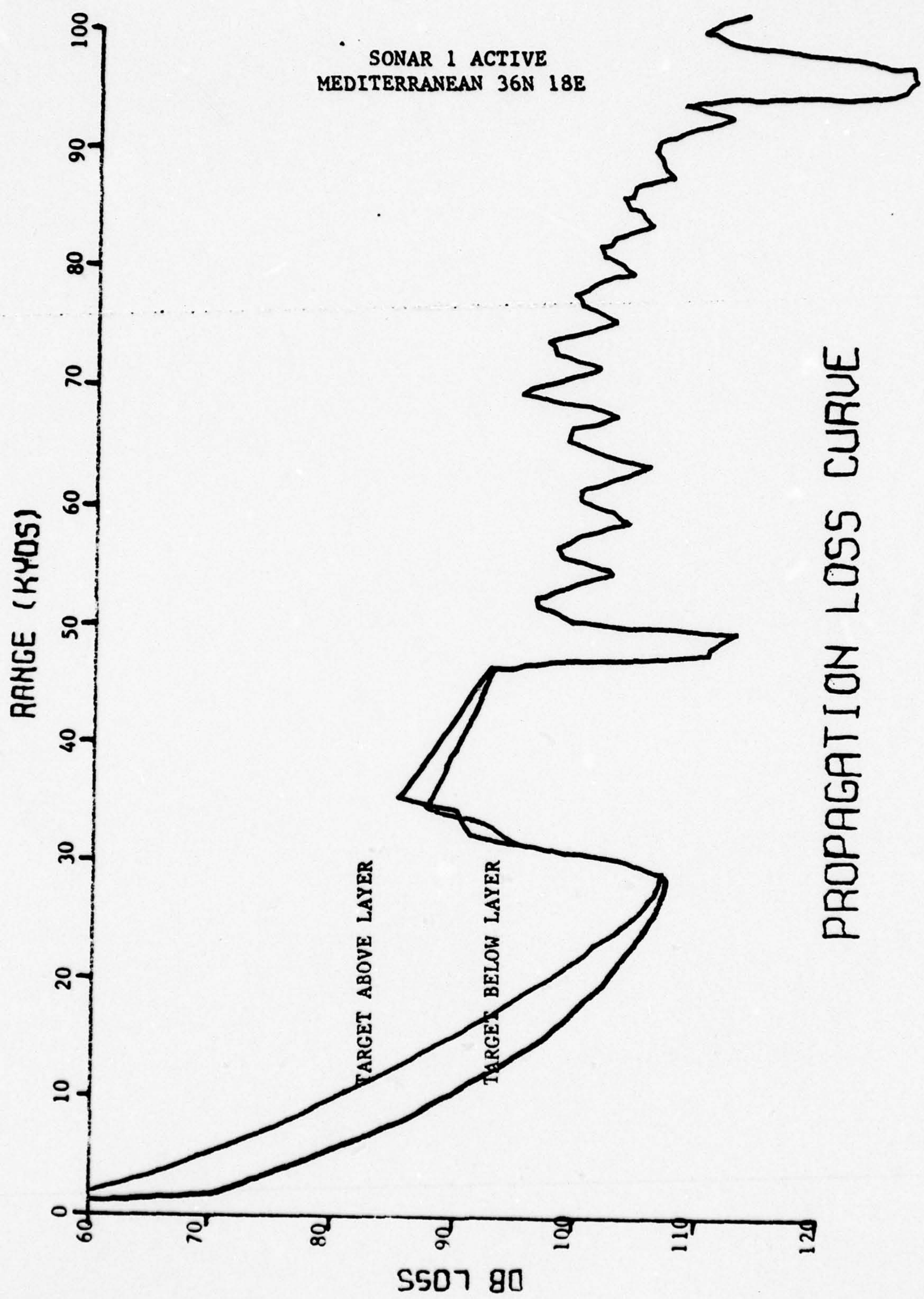

SONAR 1 & 2 PASSIVE
PACIFIC 30N 125E
PROPAGATION LOSS CURVE
RANGE (KYDS)
DB LOSS
TARGET ABOVE LAYER
TARGET BELOW LAYER
0
10
20
30
40
50
60
70
80
90
100
60
70
80
90
100
110
120


HTAS & SONOBOUY
PACIFIC 30N 125E
RANGE (KYDS)
DB LOSS
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE
0
10
20
30
40
50
60
70
80
90
100
60
70
80
90
100
110
120

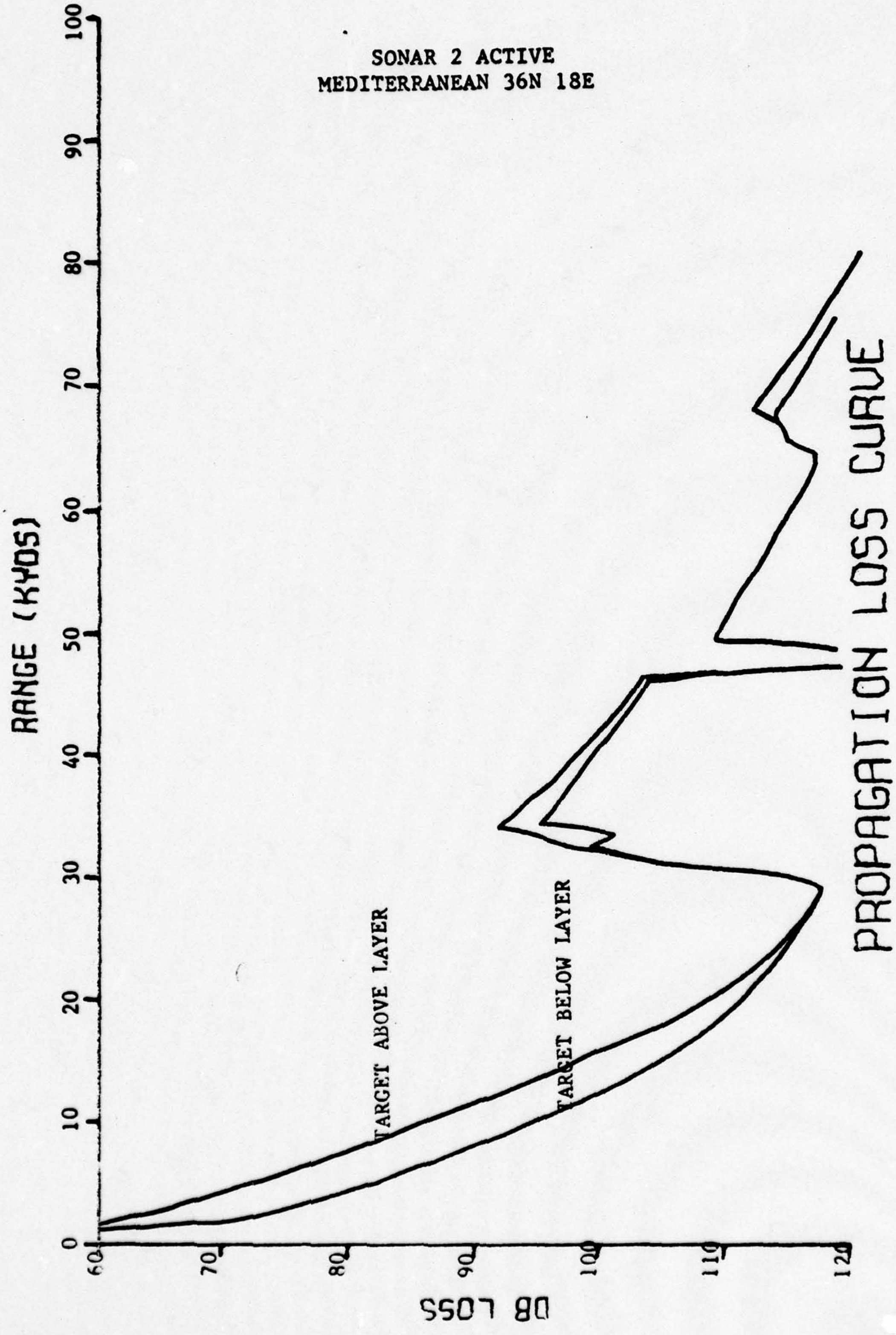
** VELOCITY PROFILE **

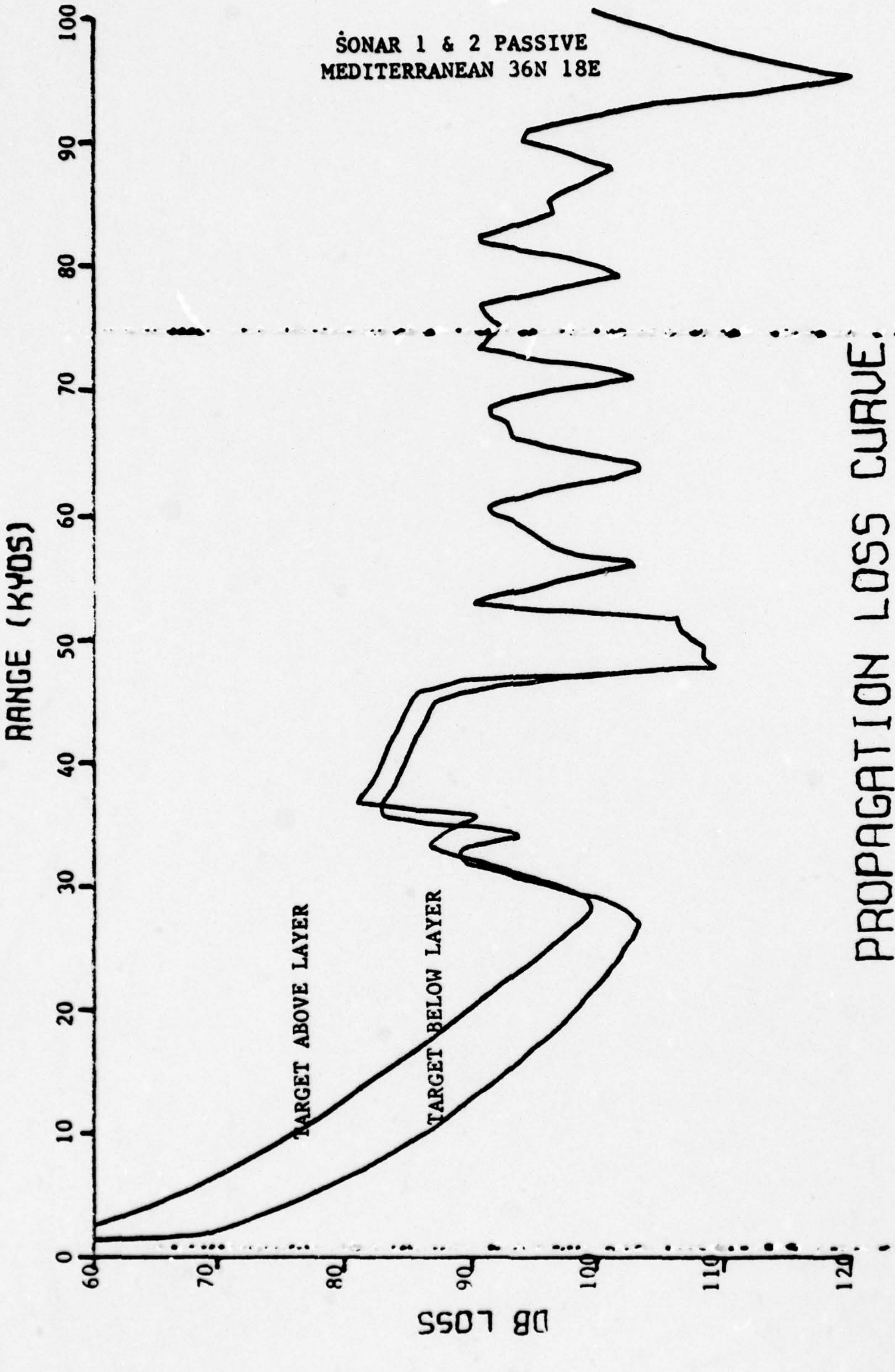


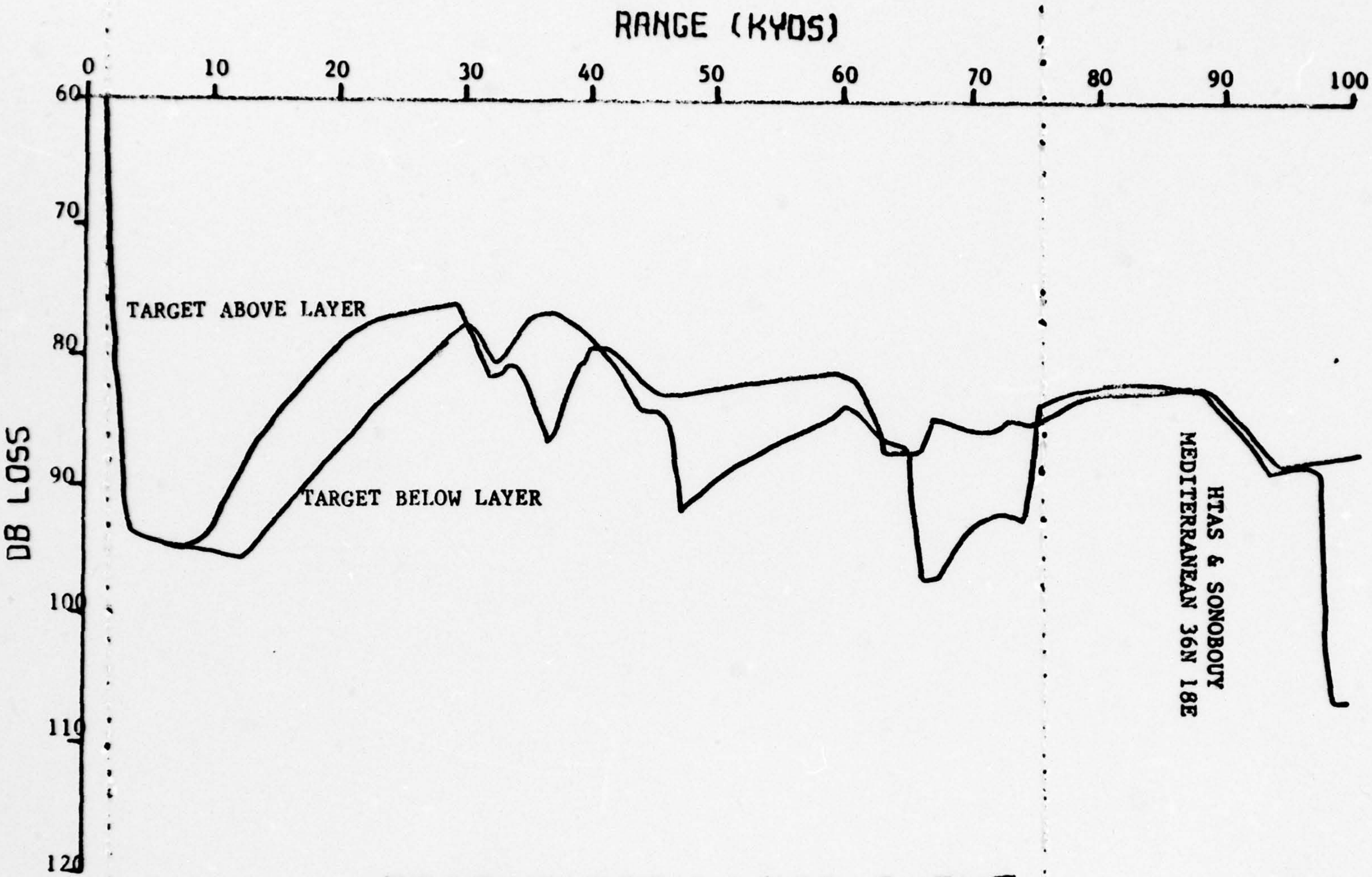
MEDITERRANEAN
(36 N 18 E)



SONAR 1 ACTIVE
MEDITERRANEAN 36N 18E
RANGE (KYDS)
0
10
20
30
40
50
60
70
80
90
100
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE
DB LOSS
60
70
80
90
100
110
120

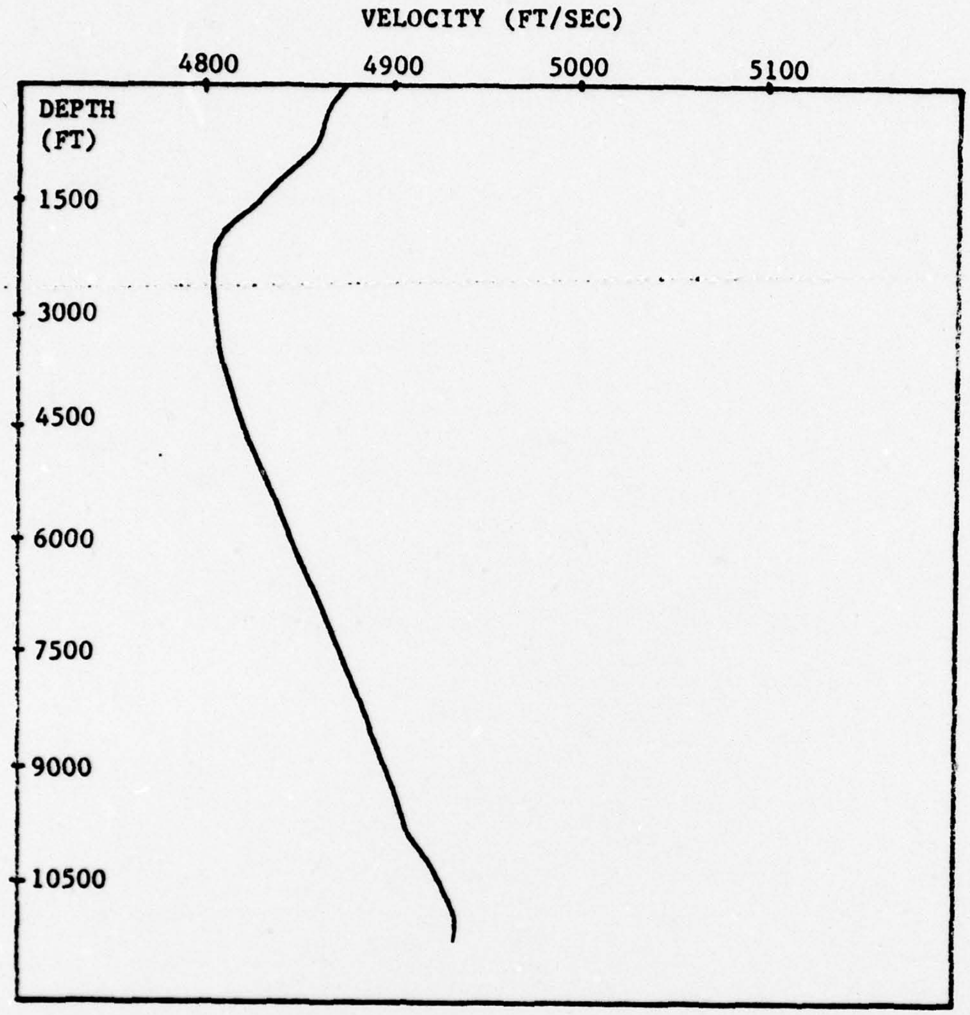

SONAR 2 ACTIVE
MEDITERRANEAN 36N 18E
RANGE (KYDS)
0
10
20
30
40
50
60
70
80
90
100
DB LOSS
60
70
80
90
100
110
120
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE


PROPAGATION LOSS CURVE
SONAR 1 & 2 PASSIVE
MEDITERRANEAN 36N 18E
TARGET ABOVE LAYER
TARGET BELOW LAYER
RANGE (KYDS)
DB LOSS
0
10
20
30
40
50
60
70
80
90
100
60
70
80
90
100
110
120

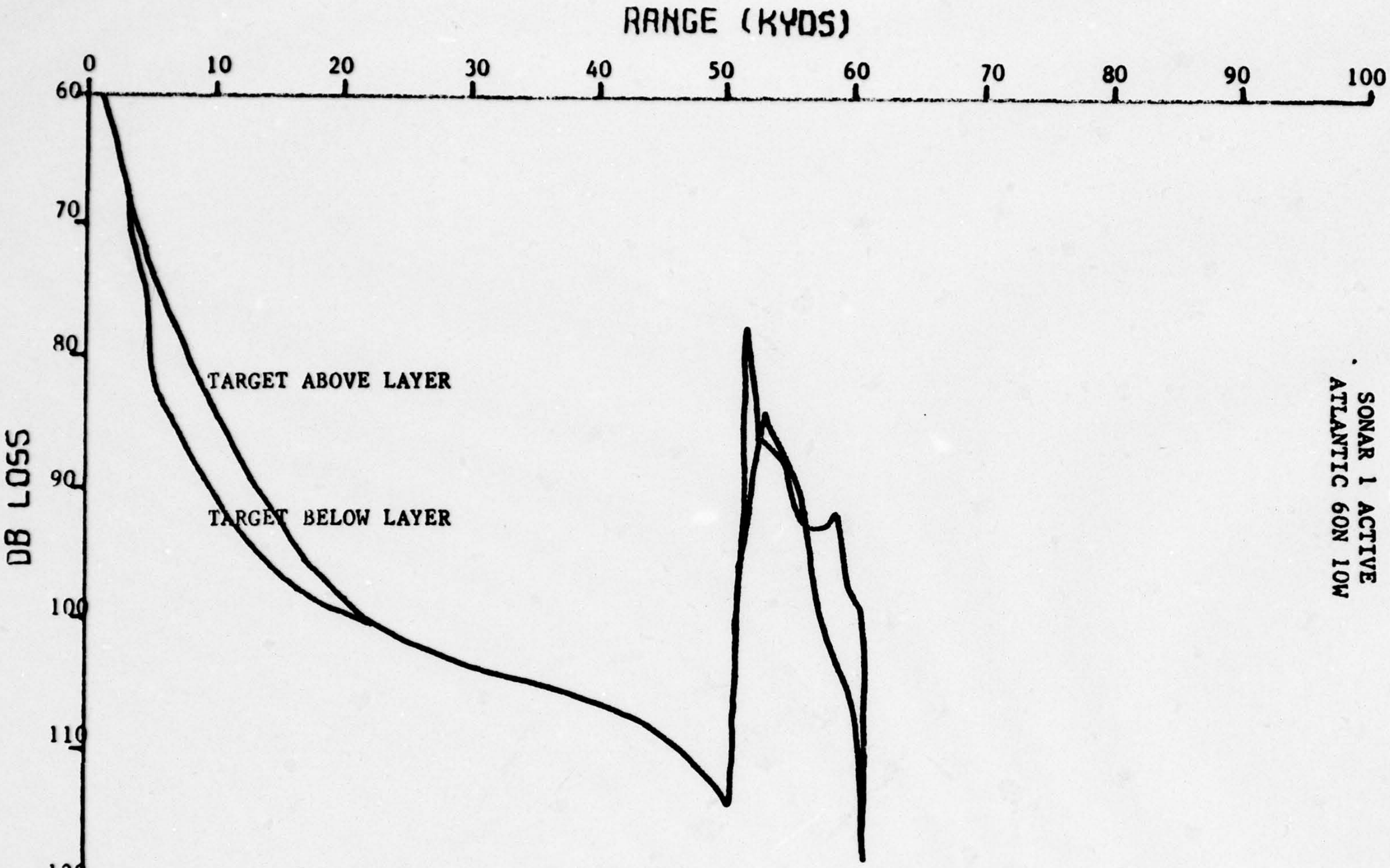


PROPAGATION LOSS CURVE

** VELOCITY PROFILE **

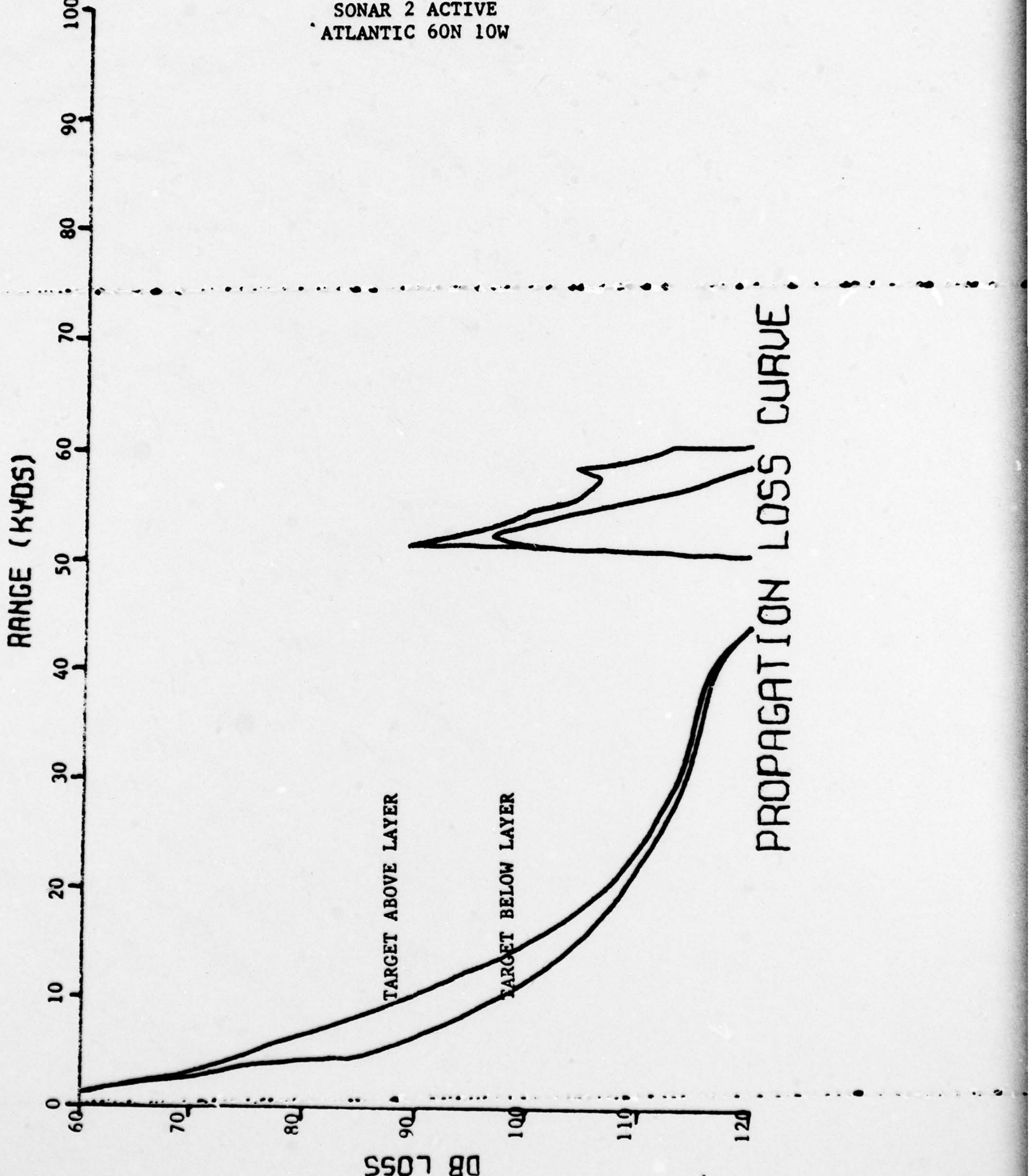


ATLANTIC
(60 N 10 W)

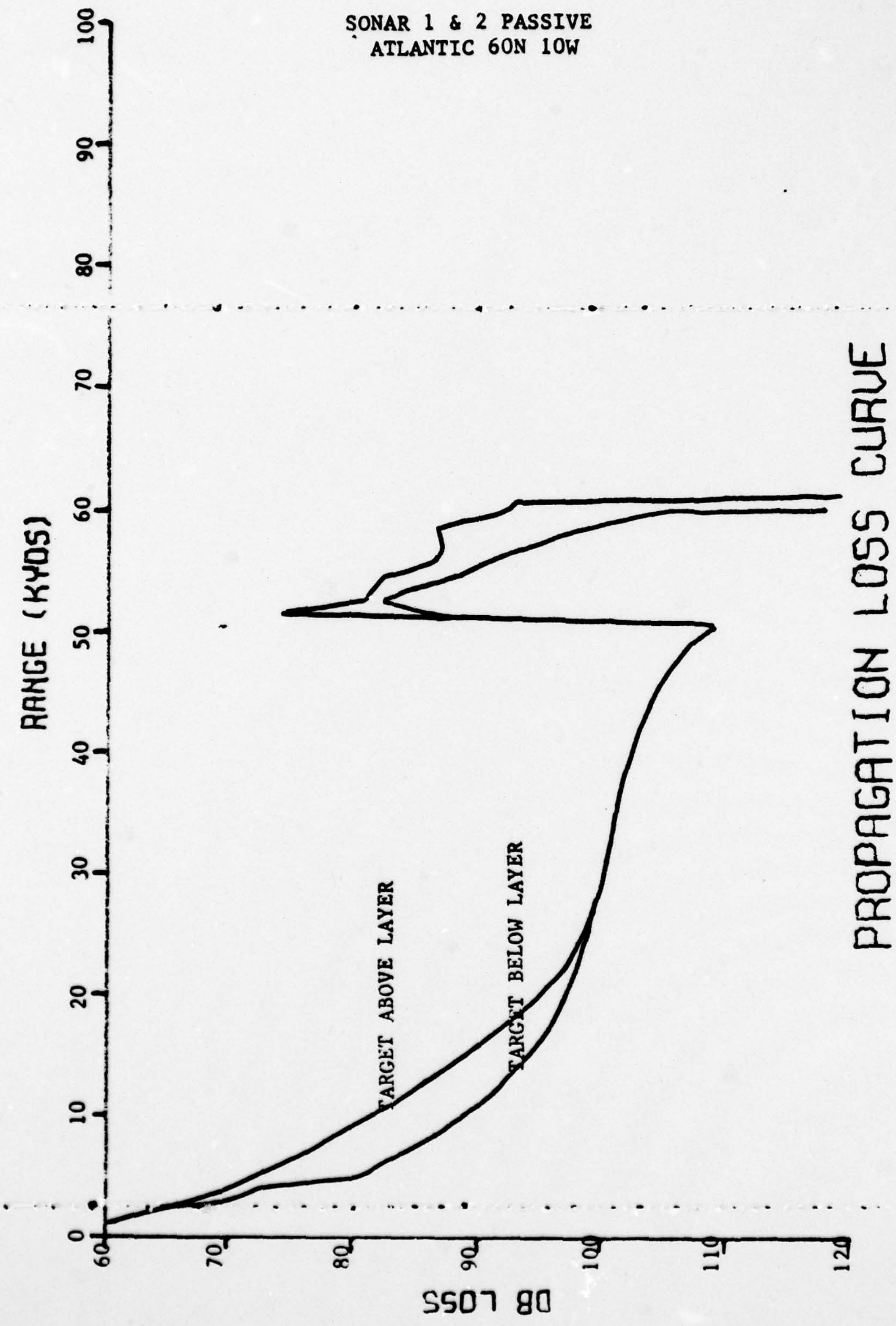


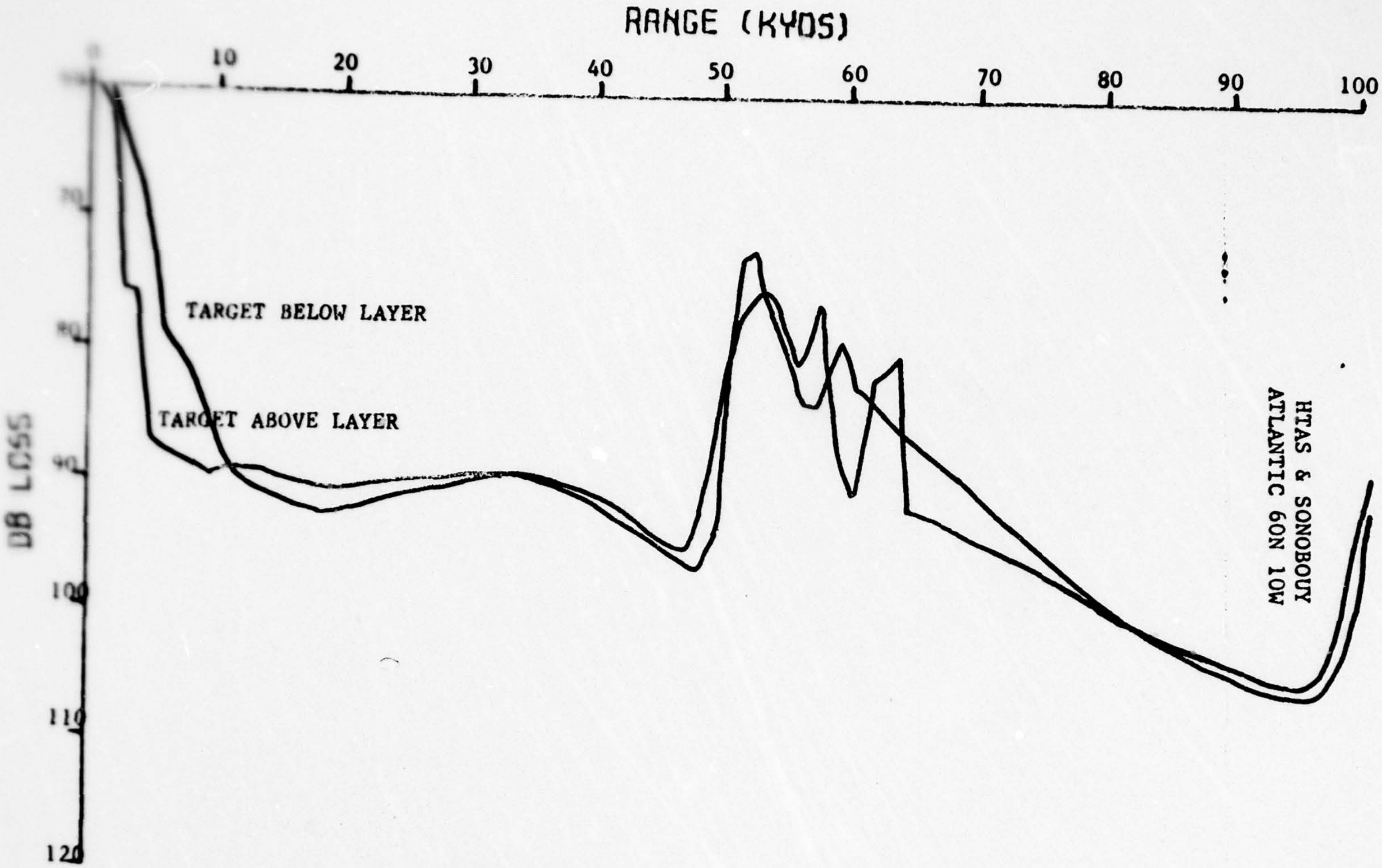
PROPAGATION LOSS CURVE

SONAR 2 ACTIVE
ATLANTIC 60N 10W



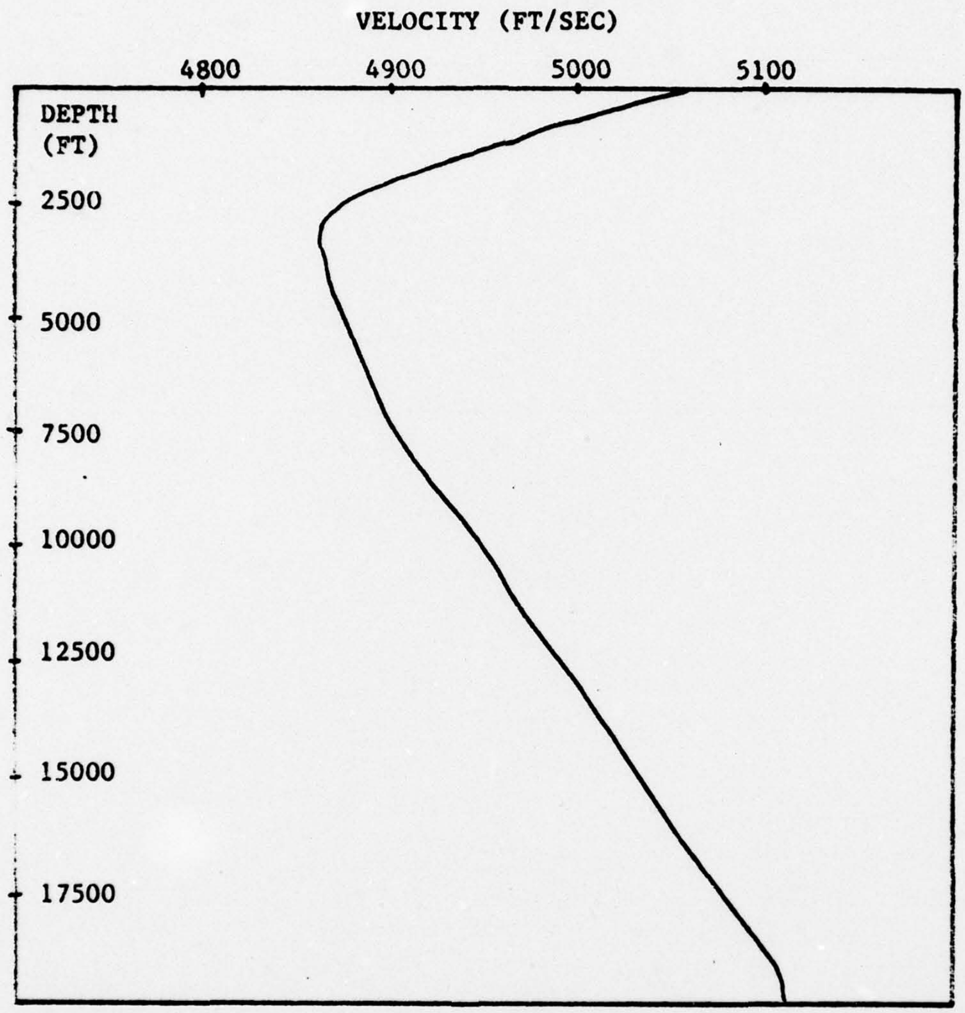
PROPAGATION LOSS CURVE


SONAR 1 & 2 PASSIVE
ATLANTIC 60N 10W
PROPAGATION LOSS CURVE
RANGE (KYDS)
DB LOSS
TARGET ABOVE LAYER
TARGET BELOW LAYER
0
10
20
30
40
50
60
70
80
90
100
60
70
80
90
100
110
120

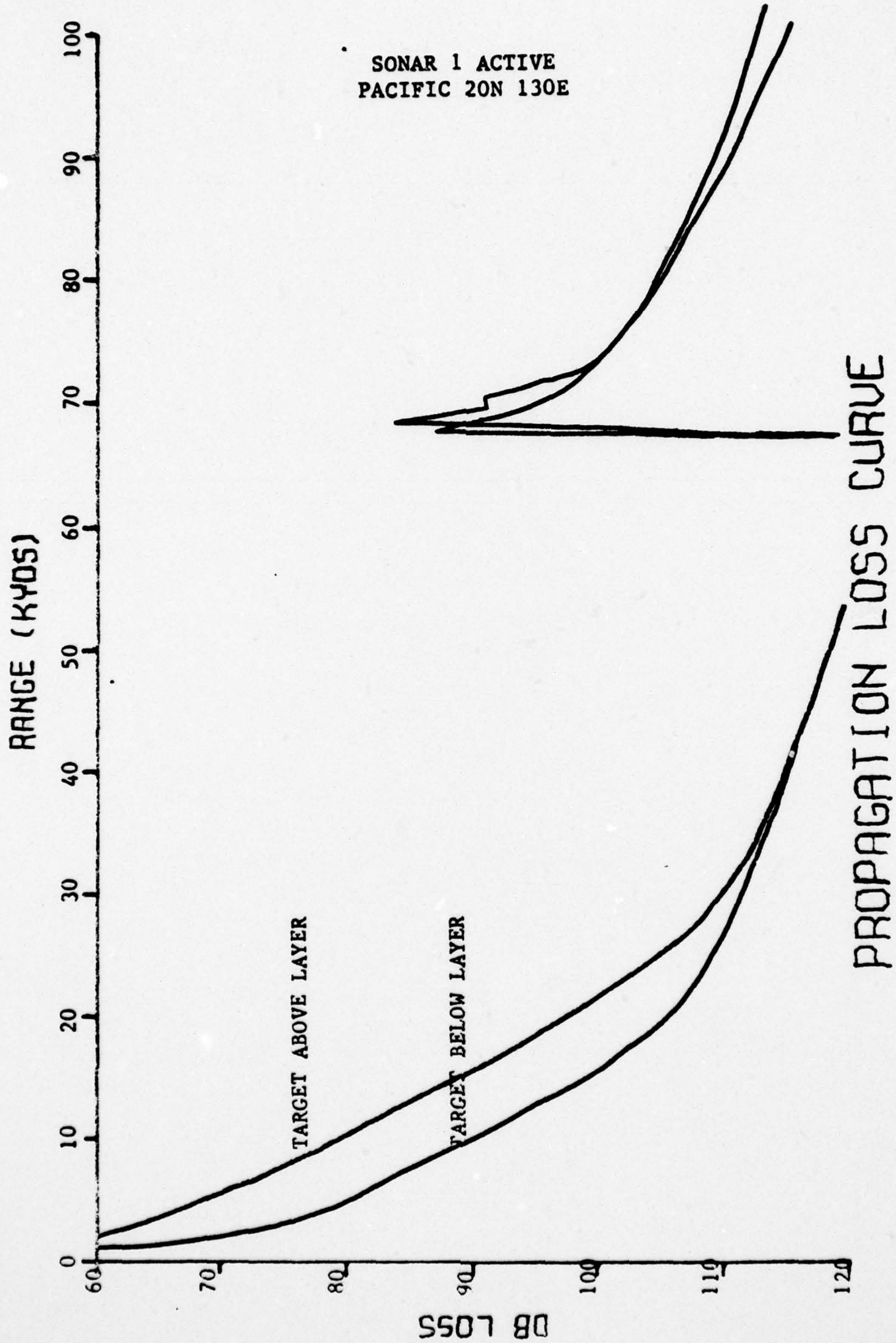


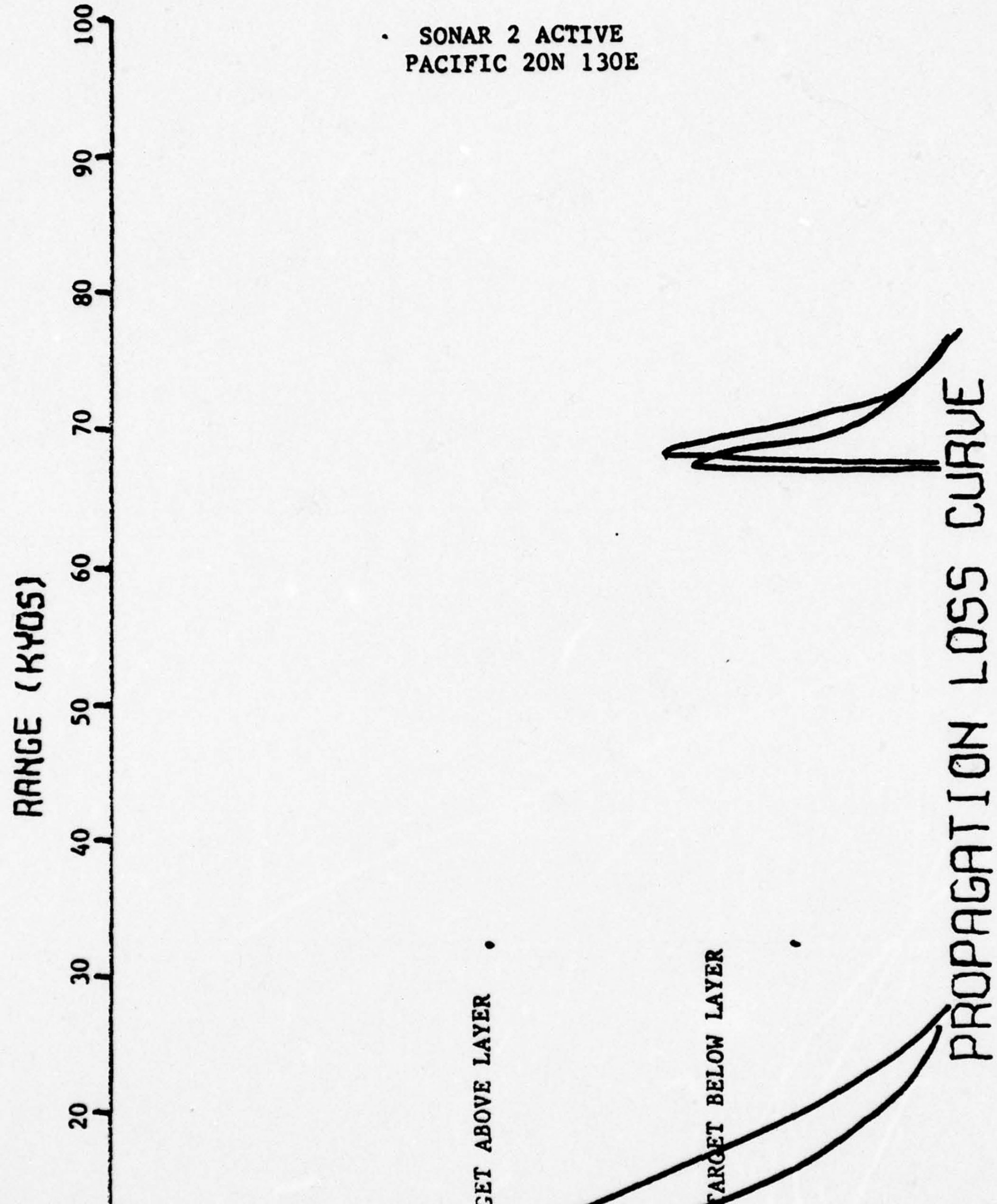
PROPAGATION LOSS CURVE

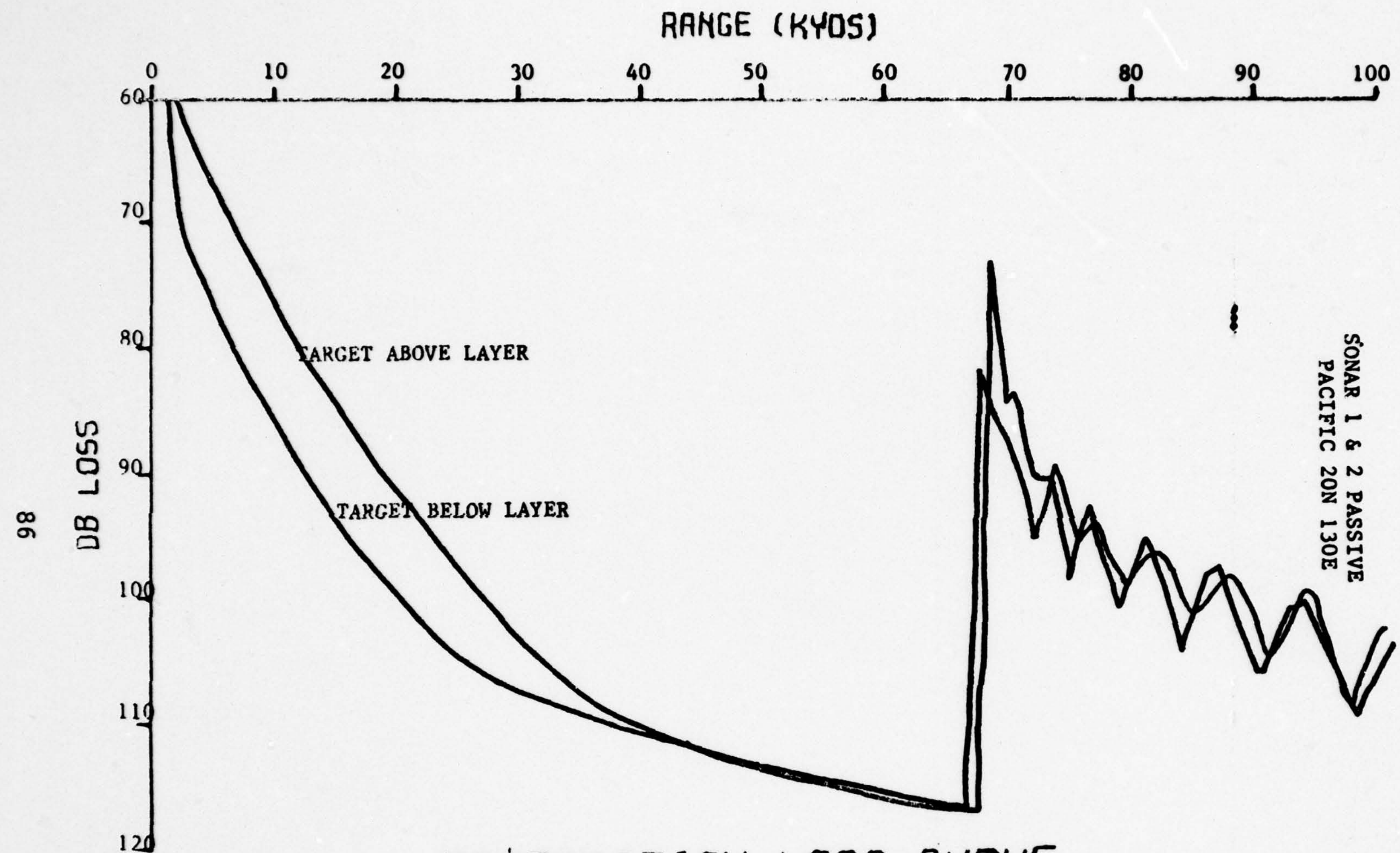
** VELOCITY PROFILE **



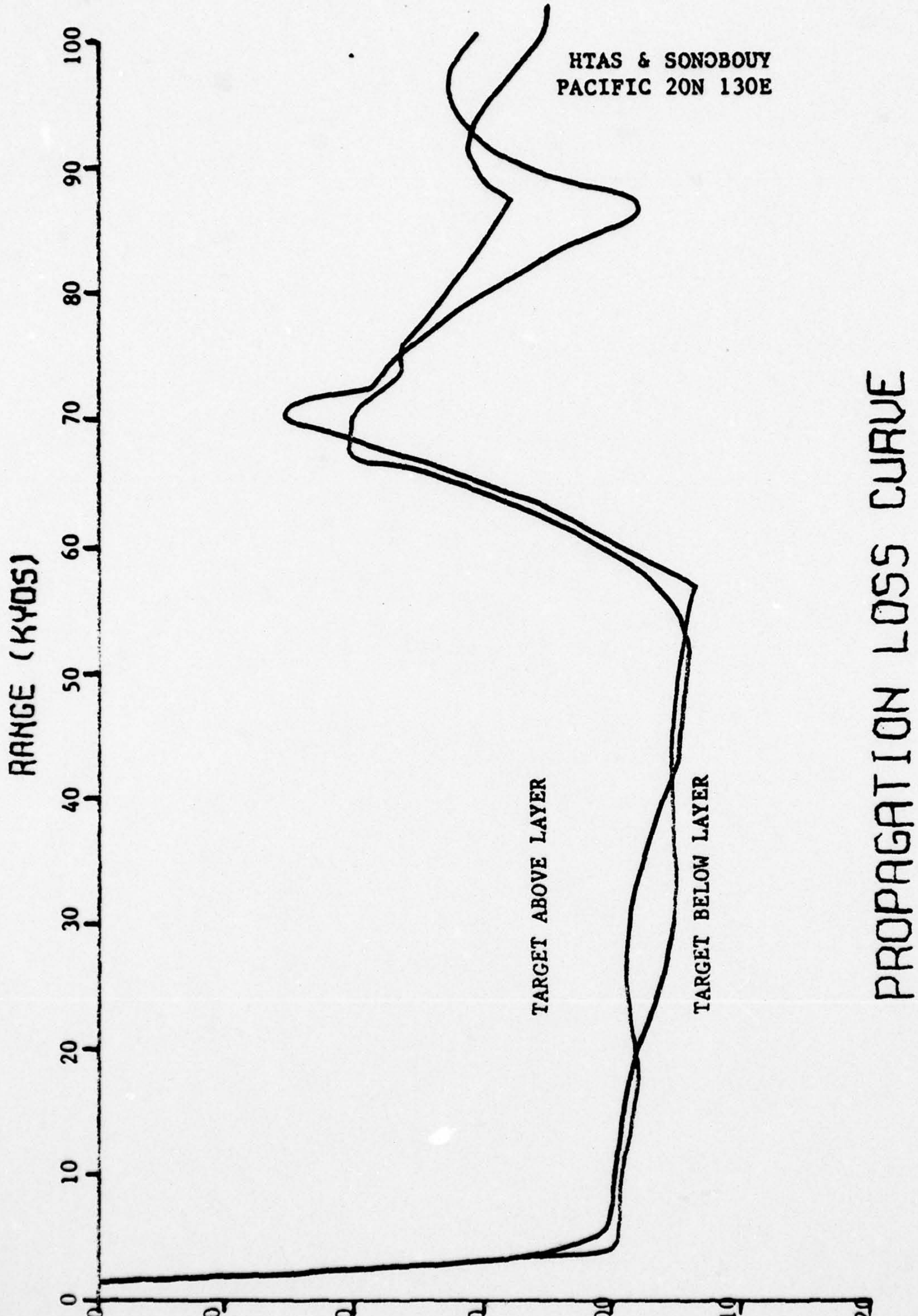
PACIFIC
(20 N 130 E)


SONAR 1 ACTIVE
PACIFIC 20N 130E
RANGE (KYDS)
DB LOSS
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE
0
10
20
30
40
50
60
70
80
90
100
60
70
80
90
100
110
120


SONAR 2 ACTIVE
PACIFIC 20N 130E
RANGE (KYDS)
0
10
20
30
40
50
60
70
80
90
100
DB LOSS
60
70
80
90
100
110
120
TARGET ABOVE LAYER
TARGET BELOW LAYER
PROPAGATION LOSS CURVE



PROPAGATION LOSS CURVE


PROPAGATION LOSS CURVE
HTAS & SONOBOUY
PACIFIC 20N 130E
TARGET ABOVE LAYER
TARGET BELOW LAYER
RANGE (KYDS)
0
10
20
30
40
50
60
70
80
90
100
DB LOSS
60
70
80
90
100
110
120

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